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ABSTRACT

MATHCO is a motivating series of audiovisual and print materials designed to overcome the negative effects of sex bias and stereotyping on the attitudes, interests, and aspirations of girls toward mathematics and mathematics-related careers. The materials teach mathematics skills, demonstrate relationships between mathematics and other subjects, and provide exposure to mathematics-related careers. They are useful for boys as well as girls at the pre- and early-adolescent stage; they are both multiethnic and nonsexist in text and illustrations. Module 5 considers the relationship between science and mathematics. The ability to make careful observations is stressed. Following the audiovisual script, 14 activities involving classification, levers, noise, archaeological digs, air pollution, and litter, among other topics, are considered, with activity worksheets for each. (MNS)

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MATHCO

University of Oklahoma
Southwest Center for Human Relations Studies
Norman, Oklahoma

Women's Educational Equity Act Program
U.S. Department of Education

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MATHCO TEACHER'S GUIDE
MODULE 5
Math and Science

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STATEMENT OF ENDORSEMENT

The National Review Board has carefully examined and heartily endorses MATHCO as a high-quality and motivating series of audiovisual and print materials designed to overcome the negative effects of sex bias and stereotyping on the attitudes, interests, and aspirations of girls toward mathematics and math-related careers.

These materials have been designed to teach math skills, demonstrate interrelationships between math and other subjects, and provide exposure to a wide variety of math-related careers. These informational and skill-building activities are valuable for boys as well as girls and are both multiethnic and nonsexist in text and illustrations.

We believe that the use of these materials with pre- and early-adolescent students can help to alleviate the math anxiety and avoidance that are characteristic of girls at these ages, resulting in their disproportionately small numbers in high-level mathematics courses and math-related careers.

Over the past two years, the Board has provided advice and assistance to the MATHCO staff as it has conceived, developed, and validated these materials. We are confident that our enthusiasm for this project will be shared by educators throughout the country.

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MODULE 5 OVERVIEW

"MATHCO's Magic Squares," a 19-minutes sound filmstrip, introduces students to the math and science concepts that they will explore in Module 5. Noting that good scientists learn how to make careful observations, students are challenged to observe carefully a series of cartoonlike picture sequences and to determine which corresponding Module 5 activity matches each sequence.

Prior to viewing this presentation, each student is given a MATHCO's Magic Squares answer sheet (see p. 3), which lists Module 5 activities on the right-hand side and the titles of the picture sequences they will be viewing on the left-hand side. Next to the picture sequence titles are "Magic Square" boxes in which students will indicate their responses. The teacher should look over this sheet with his or her students to help familiarize them with the titles, activities, and any terms that may be new to them. This review will also help students to locate their chosen responses more quickly once the filmstrip has begun.

The participatory nature of "MATHCO's Magic Squares" is structured in the following way:

1. Students view a series of pictures that illustrate a math/science concept.

2. After each picture sequence has been shown, students are given time to scan the list of Module 5 activities and to decide which activity matches the picture sequence they have just seen.

3. Students place the alphabet letter representing the MATHCO activity that they have chosen in the Magic Square next to the title of the picture sequence on their sheets.

4. The narrator then gives the correct response, allows time for students to make any needed corrections on their sheets, explains what this MATHCO activity is all about, and proceeds on to the next picture sequence.

This process repeats itself until all of the Module 5 activities have been appropriately introduced to students. The immediate feedback given by the narrator and the encouragement given for their correctly filling in any incorrect responses ensure a nonthreatening and stimulating atmosphere for participating students.

Part 2 of this audiovisual presentation does not require students to respond on their MATHCO's Magic Squares answer sheet. It provides students with a very unique introduction to the Module 5 Bonus Activity, What Do You Get When You Cross . . . ?

The MATHCO activities included in Module 5 are:

1. Classification
2. Bicycle Gears
3. Levers
4. Noise
5. Lung Capacity
6. Archaeological Dig
7. Silly Pulley
8. Proper Measurement
9. Hygrometer
10. Balloon Rockets
11. Pendulum
12. Air Pollution
13. Litter Study
14. BONUS ACTIVITY - What Do You Get When You Cross . . . ?

These activities may be done in any order that the teacher wishes. Many math teachers have used the resources of their school's science teachers in presenting some of these activities. You may wish to conduct these activities in cooperation with a science teacher; a team teaching approach to certain of these activities is often very effective. The science teacher could set up materials while you lead the discussion. However, these activities and experiments have been constructed in such a way that many math teachers (even those with little or no expertise in the area of science) have been successful in carrying out these activities with middle school students.

After students have viewed the Module 5 audiovisual, the teacher should select from Module 5 those activities that are best suited and most appropriate to his or her group of students. Some activities may be selected because they relate to the interests of students. Others will be selected because they deal with math skills with which the students are currently working, review math skills the students should know, and/or present interdisciplinary relationships that will enhance students' appreciation for the study of mathematics.

MATHCO'S MAGIC SQUARES

Picture Sequences	Magic Squares	MATHCO Activities
1. One Day at the Zoo	☐	A. Air Pollution
2. The Great Bicycle Race	☐	B. Archaeological Dig
3. The Great Garbonzos	☐	C. Balloon Rockets
4. Sporty's Solution to Noise Pollution	☐	D. Bicycle Gears
5. One Day in the Park	☐	E. Classification of the Animal Kingdom
6. One Night at the Dig	☐	F. Hygrometer (for Measuring Humidity)
7. Ding Dong Bell - Kitty's in the Well	☐	G. Levers
8. Tower of Power	☐	H. Litter Study
9. One Day at the Styling Salon	☐	I. Lung Capacity
10. One Day at the Ball Park	☐	J. Noise Levels
11. Tarzana of the Jungle	☐	K. Pendulum Study
12. The Migration of Admirable Burd	☐ ☐	L. Proper Measurement
		M. Silly Pulley

ATTENTION ALL STUDENTS:

Part 2 of the filmstrip is just for fun. When Part 2 begins, put down your pencils and enjoy!

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MODULE 5 AUDIOVISUAL SCRIPT
MATH AND SCIENCE

MATHCO'S MAGIC SQUARES

VISUAL	AUDIO
Begin audio with black frame, which follows focus frame.	(Music)
Frame 1 - (TITLE FRAME) MATHCO's Magic Squares	MATHCO presents: The Magic Squares.
Frame 2 - A MATHCO's Magic Squares answer sheet is shown.	You should have in front of you a sheet that looks like this.
Frame 3 - The left-hand side of a MATHCO's Magic Squares answer sheet is shown.	On the left side of your paper are titles which match the twelve picture sequences you are about to see.
Frame 4 - The right-hand side of a MATHCO's Magic Squares answer sheet is shown.	On the right side of your paper are listed the MATHCO activities which your class will be doing in this module.
Frame 5 - The entire MATHCO's Magic Squares answer sheet is again shown.	Your directions are as follows: Watch the picture sequences on the screen. After each sequence (or group of pictures), decide which MATHCO activity matches the picture sequence you have seen. In the Magic Square, write the letter of the MATHCO activity.

VISUAL	AUDIO
Frame 6 - An hourglass is shown having question marks changing into exclamation marks as they drop into the lower chamber.	You will have plenty of time to choose your answers, so be sure to watch the picture sequences carefully.
Frame 7 - A collage representing the tools and the subjects of scientists is shown.	A good scientist learns to observe very carefully. Let's see what kind of scientist you are today. Are you ready? Let's begin.
Frame 8 - (TITLE FRAME) One Day at the Zoo	Number 1. One Day at the Zoo.
Frame 9 - Two people are shown classifying bugs and fish.	(Music)
Frame 10 - The people are now shown classifying birds and mammals.	(Music)
Frame 11 - The people encounter a "thing" that they are unable to classify.	(Music)
Frame 12 - One of the people boots the "thing" out of the zoo.	(Music)
Frame 13 - (TITLE FRAME) One Day at the Zoo	Now, in the Magic Square beside the picture sequence entitled "One Day at the Zoo," you should write the alphabet letter which represents the MATHCO activity that matches

VISUAL	AUDIO
Frame 13 (continued)	the sequence "One Day at the Zoo." (Music is provided while students respond.)
Frame 14 - The MATHCO's Magic Squares answer sheet section for "One Day at the Zoo" is shown with an "E" appearing in the Magic Square.	Did you select letter "E," for Classification of the Animal Kingdom? If not, write "E" in your first Magic Square. In this activity, you will discover the many ways all living beings can be classified.
Frame 15 - (TITLE FRAME) The Great Bicycle Race	Number 2. The Great Bicycle Race.
Frame 16 - One cyclist is shown speeding by the other competitors.	(Music)
Frame 17 - The winner of the race is shown standing by her bike, which has dozens of gears attached to it.	(Music)
Frame 18 - (TITLE FRAME) The Great Bicycle Race	Now, write the correct letter of the alphabet in the Magic Square.
Frame 19 - The MATHCO's Magic Squares answer sheet section for "The Great Bicycle Race" is shown with a "D" appearing in the Magic Square.	Did you select letter "D," for Bicycle Gears? In this activity you will discover how different gears work on bicycles and other machines.
Frame 20 - (TITLE FRAME) The Great Garbonzos	Number 3. The Great Garbonzos.

VISUAL	AUDIO
Frame 21 - A very muscular man is shown leaping on a lever in an attempt to send a very large man flying into the air.	(Music)
Frame 22 - The very large man doesn't budge; the muscular man gets smashed.	(Music)
Frame 23 - The third member of the team, a woman, adjusts the fulcrum on the lever.	(Music)
Frame 24 - The muscular man leaps again with great determination.	(Music)
Frame 25 - The large man is propelled only slightly into the air and lands on top of the muscular man.	(Music)
Frame 26 - The Great Garbonzos are shown bowing to the audience. The woman is smiling smugly; the muscular man is in bandages.	(Music)
Frame 27 - (TITLE FRAME) The Great Garbonzos	Now, mark your Magic Square.

VISUAL	AUDIO
Frame 28 - The MATHCO's Magic Squares answer sheet section for "The Great Garbonzos" is shown with a "G" appearing in the Magic Square.	Did you write the letter "G" in your Magic Square, for Levers? In this activity you will make a lever, and by adding weights and moving the fulcrum, you will discover how levers work.
Frame 29 - (TITLE FRAME) Sporty's Solution to Noise Pollution	Number 4. Sporty's Solution to Noise Pollution.
Frame 30 - Sporty is shown being besieged by noise.	(Music)
Frame 31 - Above all the noise, Sporty hears a bird singing faintly.	(Music)
Frame 32 - Sporty gets an idea and runs off.	(Music)
Frame 33 - Sporty returns with a microphone and begins recording the singing of the bird.	(Music)
Frame 34 - Sporty amplifies the bird's singing and enjoys it as it drowns out the rest of the noise.	(Music)
Frame 35 - (TITLE FRAME) Sporty's Solution to Noise Pollution	Now, mark your Magic Square.

VISUAL	AUDIO
Frame 36 - The MATHCO's Magic Squares answer sheet section for "Sporty's Solution to Noise Pollution" is shown with a "J" appearing in the Magic Square.	Did you write the letter "J" in your Magic Square, for Noise Levels? In this activity, you will deal with different noise levels and discover how much noise your ears can take.
Frame 37 - (TITLE FRAME) One Day in the Park	Number 5. One Day in the Park.
Frame 38 - A little boy and his father are shown walking in the park. Seeing a balloon vendor, the child looks wistfully at his father. The father looks unhappy as he pulls out his pockets indicating he has no money to spend for a balloon.	(Music)
Frame 39 - The father then puts his thumb into his mouth and begins to blow.	(Music)
Frame 40 - The father has blown himself up. The child walks happily along holding a string to which his floating father is attached.	(Music)
Frame 41 - (TITLE FRAME) One Day in the Park	Now, mark your Magic Square.

VISUAL	AUDIO
Frame 42 - The MATHCO's Magic Squares answer sheet section for "One Day in the Park" is shown with an "I" appearing in the Magic Square. (Balloon Rockets might also be chosen here.)	Did you select MATHCO activity "I," Lung Capacity? In this activity, you will make a device that will measure the amount of air in your lungs. Be careful, we don't want you to blow yourself into outer space!
Frame 43 - (TITLE FRAME) One Night at the Dig	Number 6. One Night at the Dig.
Frame 44 - A mummy appears between two archaeologists who are working at a dig.	(Music)
Frame 45 - The mummy grabs the two archaeologists, who look startled and astonished.	(Music)
Frame 46 - Time has elapsed. The mummy and the two archaeologists are shown appearing as guests on the "Tonight" show.	(Music)
Frame 47 - (TITLE FRAME) One Night at the Dig	Now, mark your Magic Square.
Frame 48 - The MATHCO's Magic Squares answer sheet section for "One Night at the Dig" is shown with a "B" appearing in the Magic Square.	If you selected "B," Archaeological Dig, you are correct. In this activity, everyone becomes an archaeologist . . . and, what's more, you get to create a "dig."

VISUAL	AUDIO
Frame 49 - (TITLE FRAME) Ding, Dong, Bell - Kitty's in the Well	Number 7. Ding, Dong, Bell - Kitty's in the Well.
Frame 50 - Hearing strange sounds from a well, a man attempts to rescue whatever's trapped down in it.	(Music)
Frame 51 - The man pulls out a ferocious-looking creature, which hugs him gratefully.	(Music)
Frame 52 - (TITLE FRAME) Ding, Dong, Bell - Kitty's in the Well	Now, mark your Magic Square.
Frame 53 - The MATHCO's Magic Squares answer sheet section for "Ding, Dong, Bell - Kitty's in the Well" is shown with an "M" appearing in the Magic Square.	The answer is "M," Silly Pulley. In this activity, you will discover how one student can have the advantage over <u>two</u> other students by using a pulley.
Frame 54 - (TITLE FRAME) Tower of Power	Number 8. Tower of Power.
Frame 55 - The King, the Wise One, and a great tower are shown.	"How high is the great tower?" demanded the King of Power of the Ancient Wise One.
Frame 56 - The King and the Wise One are shown talking.	"According to the shadows on the sand," replied the Wise One, "the tower is now a million cubits high." "Good!" said the King.

VISUAL	AUDIO
Frame 57 - A great commotion is represented by the word ZAP!!!	Suddenly . . .
Frame 58 - People are shown trying to communicate using many different systems of measurement.	from that moment on, everyone used a different system of measure. People could not understand one another.
Frame 59 - The King is shown along with the Tower of Power, which is now for sale.	So, with many methods of measurement, the world was divided and the Tower of Power became the world's first empty high-rise apartment building.
Frame 60 - (TITLE FRAME) Tower of Power	Now, mark your Magic Square.
Frame 61 - The MATHCO's Magic Squares answer sheet section for "Tower of Power" is shown with an "L" appearing in the Magic Square.	Did you select "L," Proper Measurement? In this activity, you will discover that there are many tools with which you can measure various objects. Can you use parts of <u>your body</u> as a measuring tool?
Frame 62 - (TITLE FRAME) One Day at the Styling Salon	Number 9. One Day at the Styling Salon.
Frame 63 - Four people are shown sitting under hair dryers. One of them is reading a newspaper that indicates that it is very humid outside.	(Music)

VISUAL	AUDIO
Frame 64 - The four people are all shown sporting brand-new hairdos.	(Music)
Frame 65 - The people go outside and their hairdos react to the humidity.	(Music)
Frame 66 - (TITLE FRAME) One Day at the Styling Salon	Now, you may mark your Magic Square.
Frame 67 - The MATHCO's Magic Squares answer sheet section for "One Day at the Styling Salon" is shown with an "F" appearing in the Magic Square.	The correct response is the letter "F," Hygrometer (for Measuring Humidity). In this activity, you and your classmates will build an instrument with which to measure humidity, or moisture, in the air. You will then record your results on a graph.
Frame 68 - (TITLE FRAME) One Day at the Ball Park	Number 10. One Day at the Ball Park.
Frame 69 - A baseball player is shown making a long, high hit.	(Music)
Frame 70 - The ball flies out of the stadium toward a blimp, which is circling overhead.	(Music)
Frame 71 - The ball hits the blimp, which immediately deflates and begins to spin.	(Music)
Frame 72 - (TITLE FRAME) One Day at the Ball Park	Now, mark your Magic Square.

VISUAL	AUDIO
Frame 73 - The MATHCO's Magic Squares answer sheet section for "One Day at the Ball Park" is shown with a "C" appearing in the Magic Square.	Did you select letter "C," Balloon Rockets? In this activity, you will propel a balloon across the room and make some very interesting discoveries.
Frame 74 - (TITLE FRAME) Tarzana of the Jungle	Number 11. Tarzana of the Jungle.
Frame 75 - A man is about to fall off of a high bridge. Tarzana gets a rope.	(Music)
Frame 76 - A rescue seems at hand.	(Music)
Frame 77 - Tarzana swings out and her hand grasps the arm of the stranded man.	(Music)
Frame 78 - The rescue completed, Tarzana is shown holding the man in her arms.	(Music)
Frame 79 - (TITLE FRAME) Tarzana of the Jungle	Now, you may mark your Magic Square.
Frame 80 - The MATHCO's Magic Squares answer sheet section for "Tarzana of the Jungle" is shown with a "K" appearing in the Magic Square.	If you marked letter "K," Pendulum Study, you are correct. In this activity, you will make some interesting discoveries about how length and weight affect the swing of a pendulum.

VISUAL	AUDIO
Frame 81 - (TITLE FRAME) The Migration of Admirable Burd	Number 12. The Migration of Admirable Burd.
Frame 82 - Admirable Burd is shown flying south.	(Music)
Frame 83 - Admirable Burd encounters a lot of air pollution, which makes it cough.	(Music)
Frame 84 - Quite sickened by now, Admirable Burd decides to return home.	(Music)
Frame 85 - Admirable Burd is shown at a bus stop that is strewn with litter.	(Music)
Frame 86 - (TITLE FRAME) The Migration of Admirable Burd	Now, mark your Magic Square.
Frame 87 - The MATHCO's Magic Squares answer sheet sections for "The Migration of Admirable Burd" are shown with an "A" and an "H" in the Magic Squares.	Surprised? Did you select two activities? If you selected "A," Air Pollution, and "H," Litter Study, you are correct. In these activities, you will examine the pollution in the air and the pollution caused by "litter bugs."
Frame 88 - (TITLE FRAME) Part 2	(Music)

VISUAL	AUDIO
Frame 89 - The frame reads: What do you get when you cross . . .	What do you get when you cross . . .
Frame 90 - The frame reads: a small cat with a hawk?	a small cat with a hawk?
Frame 91 - A picture of a "Kittyhawk" is shown.	A Kittyhawk? (Spoken incredulously)
Frame 92 - The frame reads: What do you get when you cross . . .	What do you get when you cross . . .
Frame 93 - The frame reads: an elephant with an alligator?	an elephant with an alligator?
Frame 94 - A picture of an "Elephator" is shown.	An Elephator?
Frame 95 - The frame reads: What do you get when you cross . . .	What do you get when you cross . . .
Frame 96 - The frame reads: a Brahma bull with a crocodile?	a Brahma bull with a crocodile?
Frame 97 - A picture of a "Crocabull" is shown.	A Crocabull?
Frame 98 - The frame reads: What do you get when you cross . . .	What do you get when you cross . . .

VISUAL	AUDIO
Frame 99 - The frame reads: a rooster with a little dog?	a rooster with a little dog?
Frame 100 - A picture of a "Pup-a-Roo" is shown.	A Pup-a-Roo?
Frame 101 - A collage depicting the animals from frames 91, 94, 97, and 100 is shown.	How many of these combinations were you able to guess? Such animal combinations are impossible in real life. But sometimes it is fun to think about "what if?"
Frame 102 - The frame reads "BONUS" in bold letters.	For the adventurous among you, there is a "BONUS" activity in this module. If you are interested, ask your teacher to tell you about it.
Frame 103 - A teenaged girl and boy are shown in a scientific laboratory setting.	Some of the examples you have seen today might never happen in real life, but they all illustrate basic scientific principles. As you and your classmates explore the activities in this MATHCO module, you may discover a career in science that is just right for you.
Frame 104 - (CREDIT FRAME) Audiovisual developers.	(Music)
Frame 105 - (CREDIT FRAME) MATHCO developers.	(Music)
Frame 106 - (CREDIT FRAME) MATHCO National Review Board.	(Music)

VISUAL	AUDIO
Frame 107 - (DISCLAIMER FRAME)	(Music)
Frame 108 - (THE END FRAME)	(Music)

MODULE 5 ACTIVITIES

These MATHCO activities are designed to help students discover that basic mathematical concepts already familiar to them are also appropriate to elements found in science. Under your guidance, students will also become acquainted with careers that draw upon the math skills they will be using in these activities.

1. CLASSIFICATION Page 23

   Using their Classification Worksheets, students divide and subdivide themselves into smaller and smaller groups until each individual student fits only one set of listed characteristics.

   SKILLS USED: Knowledge of sets and a keen sense of observation

2. BICYCLE GEARS Page 33

   Students take a close look at how bicycle gears work and discover the ways gears help the cyclist.

   SKILLS USED: Measuring distances, multiplication, division, and an understanding of ratios

3. LEVERS Page 43

   Students construct a simple lever, and through experimenting by adding weights and moving the fulcrum, they learn how this simple machine works.

   SKILLS USED: Multiplication, division, and a knowledge of equations

4. NOISE Page 51

   Students graph noise level data to discover which decibel levels can cause damage to their ability to hear.

   SKILLS USED: Making and understanding a simple bar graph

5. LUNG CAPACITY Page 57

You and your students, as a group, build a simple device that will measure the amount of air that is contained in their lungs. After a comparison of lung capacities, students construct a histogram to exhibit their findings.

SKILLS USED: Measuring, averaging, and charting

6. ARCHAEOLOGICAL DIG Page 67

Groups of students create "archaeological digs" through researching or inventing civilizations, creating artifacts, and burying them. Each group then excavates and charts a "dig" that another group has created.

SKILLS USED: Division, working with a grid, and finding the area of a space, given its dimensions

7. SILLY PULLEY Page 73

An experiment demonstrates how one student can, with the help of a simple pulley, have a strength advantage over two other students. Students learn more about pulleys and how they work to aid people.

SKILLS USED: Multiplication and division of simple numbers

8. PROPER MEASUREMENT Page 83

Students use parts of their bodies to measure various objects and sections of their classroom. They will discover the significance of commonly agreed upon systems of measurement.

SKILLS USED: Measuring and multiplication of large (astronomical) numbers

9. HYGROMETER Page 89

You and your students, as a group, construct a simple instrument that measures humidity. Students will make some observations and graph their humidity readings for at least one week.

SKILLS USED: Making graphs and finding needed information on a chart

10. BALLOON ROCKETS Page 99

Students propel balloons across the classroom on a string or wire and calculate each balloon's speed.

SKILLS USED: Measuring, division, and using the second hand on a watch or clock

11. PENDULUM Page 105

Students time the swings of pendulums constructed with various length strings and various weight bobs. They will compare their findings and discover some basic principles about pendulums.

SKILLS USED: Multiplication, keeping records, and timing

12. AIR POLLUTION Page 113

Students conduct an experiment to discover which areas, inside and outside of their school, are most polluted (contain the most airborne particles).

SKILLS USED: Rating and graphing

13. LITTER STUDY Page 119

Students collect and classify the types of litter found around the outside of your school and compare their findings with the results of a nationwide litter study.

SKILLS USED: Counting and figuring percentages

14. WHAT DO YOU GET WHEN YOU CROSS . . . ? Page 125
(Bonus Activity)

Students hypothetically "cross" two dissimilar animals, do research to learn their animals' characteristics, and, after completing their Worksheets and drawing their animals, rate their own work.

MODULE 5, NUMBER 1 - CLASSIFICATION

Teacher Activity Sheet

Overview

In this activity your students will divide and subdivide themselves into groups until each student fits only one list of characteristics.

Math Skills Your Students Will Need

Knowledge of sets and a keen sense of observation.

Time Allotment

One class period.

Objectives

Your students will:

1. Divide the class into groups and subgroups until each student fits only one list of characteristics.
2. Discover the importance of classifying living things.
3. Discover the importance of using classification keys.

Materials Your Class Will Need

Classification Worksheets, paper, and pencils.

Vocabulary

kingdom
phylum
class
order
family
genus
species

Your students do not have to know the definition of each of these words. They just need to know that kingdom is the largest grouping of animals and plants and that the groupings get smaller and more particular, finally ending with species. A species includes only one kind of plant or animal.

Self-Concept Builder

Your students will work in groups, and each student will be given a classification of his or her own in class. Each student will emerge as a particular, unique species.

CAUTION: Be sure student groups avoid using descriptions of physical characteristics that may embarrass some students (e.g., tall, short, fat, skinny, short hair).

Activity

1. In reference to the Classification Worksheet, pages one and two, divide your class into groups of eight, by rows or by sections of the classroom. All students will start together with the name of the class as the most inclusive group (Mr./Ms. Jones, Math Class, 4th Period). The next division will be how you decided to group your students (first row, back right-hand quarter of classroom, etc.). With the aid of the Worksheet, the groups will continue to subdivide into smaller and smaller categories until each student has his or her own category. The classifications should not include the students' names. (See the teacher's copy of the Worksheet for ideas on classifying.)

2. The groups should exchange their Classification Worksheets with one another and see if they can match the names of the students with their categories.

3. Your students should now complete pages three and four of the Classification Worksheet.

4. Discuss with your class how pages one and two compare with pages three and four of the Worksheet.

Occupations Related to This Activity

What occupations might use an activity similar to this one? Have your students complete the career section on their Activity Sheet. After class discussion, they should add these occupations to the list:

BOTANIST

BIOLOGIST

TAXONOMIST

ZOO CURATOR

ARCHAEOLOGIST

PALEONTOLOGIST (one who studies fossils and ancient life forms)

Discuss the types of courses people going into these occupations should take in high school. Have your students add these courses to their Activity Sheet.

Stress that men and women can be equally successful in most careers, if they are qualified.

Suggested Independent Activities

(These suggestions appear on Student Activity Sheet.)

1. Go to the library and discover what characteristics scientists look for in classifying plants and animals.

2. Take a trip to the zoo. Notice how animals in the zoo are grouped. Also, notice the scientific names of the animals.

MODULE 5, NUMBER 1 - CLASSIFICATION

Student Activity Sheet

Your Name _____ Date _____

Overview

In this activity, you will discover how you and your classmates can be divided again and again until you and only you fit a particular list of characteristics.

Math Skills You Need to Remember

Knowledge of sets and a keen sense of observation.

Things You Will Need

Classification Worksheet, paper, and a pencil.

Vocabulary

kingdom
phylum
class
order
family
genus
species

You do not have to know the definition of each of these words. Just know that kingdom is the largest grouping of animals or plants and that the groupings get smaller and more particular, finally ending with species. A species includes only one kind of plant or animal.

When You Finish You Will Be Able To

Explain how and why plants and animals are classified in a scientific way.

Activity

1. Your teacher will place you in groups. Get together with your group and work on your Classification Worksheet, pages one and two.

2. Exchange your findings with another group. Try to match the names of the students in the group with their categories.

3. Now, do pages three and four of your Classification Worksheet.

4. Be prepared to discuss with your class how pages one and two compare with pages three and four of the Worksheet.

Occupations Related to This Activity

(You may check the MATHCO Career Wall Charts to get more information about a career in which you are interested.)

OCCUPATIONS	SUBJECTS NEEDED IN HIGH SCHOOL

Are you interested in any of these careers? Remember, you can be anything you want to be--if you are qualified.

Men and women can do the same jobs with equal success. Can't both women and men enter each of the occupations you've listed above?

Exploring on Your Own

1. Go to the library and discover what characteristics scientists look for in classifying plants and animals.

2. Take a trip to the zoo. Notice how animals in the zoo are grouped. Also, notice the scientific names of the animals.

MODULE 5, NUMBER 1 - CLASSIFICATION

Worksheet

Use the following instructions to complete the classification of your group. These directions are numbered to match the numbers of the classification chart you will be using, which is on page two.

---

1. Your first two divisions have been done for you. On the first blank, write in your teacher's name, the class, and the period. (EXAMPLE: Mr./Ms. Jones, Math Class, 4th Period.) This is the largest classification of your class.

2. On the next blank, write the way your teacher has divided your class into groups. (EXAMPLE: Row 1, Row 2, Row 3, etc., OR the front right-hand corner of the room, the back left-hand corner of the room, etc.) Write down whatever characteristic it is that distinguishes your group.

3. Now for the fun part! Look carefully at the people in your group. With them, decide upon another characteristic that can divide your group into two equal groups--Group I and Group II. (EXAMPLE: eye color, hair color or style, clothing, types of shoes, etc.--use your imaginations!) Write the characteristic you have chosen on the blanks under Group I and Group II.

4. Look carefully at the people who are now in Group I. Divide this group into Group IA and Group IB, again in even numbers if possible--two students in each group. Write down the characteristics used to make this division in the blanks provided. Do the same for Group II.

5. Divide Group IA into two groups--Group IA_1 and Group IA_2. Write down the characteristics used to make this division in the blanks provided. Do the same for Group IB, Group IIA, and Group IIB.

   5A. If, for some reason, your teacher has grouped you together with more than seven other students, you should continue to divide your groups until only one student remains in any particular group.

6. Provided that you started out with eight or fewer students in your original group, you are now ready to write your name in the appropriate blank under the set of characteristics that classify YOU AND ONLY YOU. Before doing this, exchange your Worksheet with another group to see if its members can guess which student matches each set of characteristics. At the same time, see if you can determine which students match the sets of characteristics listed on the other group's classification sheet. Now, fill in the blanks at the bottom of your chart.

CLASSIFICATION CHART - *Teacher's Sample*

1. *Mr./Ms. Jones, Math Class, 4th Period*

2. *Row 1*

   Group I — Group II

3. *Male* (IA — IB) — *Female* (IIA — IIB)

4. *wearing tennis shoes* (IA_1 — IA_2) — *not wearing tennis shoes* (IB_1 — IB_2) — *straight hair* (IIA_1 — IIA_2) — *curly hair* (IIB_1 — IIB_2)

5. *solid-color shirt* — *patterned shirt* — *wearing blue jeans* — *not wearing blue jeans* — *wearing dress* — *wearing pants* — *pierced ears* — *nonpierced ears*

5A. *(Space provided for more divisions, if necessary.)*

6. *Eddie* NAME — *Bill* NAME — *Raymond* NAME — *Kevin* NAME — *Tina* NAME — *Anne* NAME — *Julie* NAME — *Paula* NAME

SEE HOW UNIQUE AS A PERSON YOU REALLY ARE!

How and Why Scientists Classify Animals

There are nearly two million different kinds of animals on the planet Earth. It would be impossible for any one person to learn the characteristics of each and every one of these animals. For this reason, scientists over the last 300 years have been placing animals into groups according to their characteristics. If scientists come across an unfamiliar animal, but know its classification, they already have a lot of information about that animal.

In order to see how this system works, look at the way scientists have classified YOU . . . a human. Notice that the top grouping, Kingdom, is the largest group and the Species (which is the smallest group) includes only one kind of living being.

KINGDOM	-	ANIMAL	(living beings which differ from plants because they can move spontaneously and react to stimulation)
PHYLUM	-	CHORDATA	(all animals with backbones)
CLASS	-	MAMMALIA	(all animals that nourish their young with milk; their skin is usually covered with hair)
ORDER	-	PRIMATES	(mammals of the highest order--humans, apes, monkeys, etc.)
FAMILY	-	HOMINIDAE	(mammals that walk upright--humans, human ancestors, and other related forms)
GENUS	-	HOMO	(humans and extinct humanlike beings)
SPECIES	-	SAPIENS	(the scientific name that applies only to humans; Homo sapiens is YOUR scientific name)

Here are two more animals. They start out together in the Animal Kingdom, but break away at the Family level. Can you figure out what their common names are?

KINGDOM - ANIMAL

PHYLUM - CHORDATA

CLASS - MAMMALIA

ORDER - CARNIVORA

FAMILY	-	FELIDAE	FAMILY	-	CANIDAE
GENUS	-	FELIS	GENUS	-	CANIS
SPECIES	-	CATUS	SPECIES	-	FAMILIARIS

Common Name? *cat*

Common Name? *dog*

How are these two animals similar to human beings? *Both have back-bones, both are mammals, etc.*

How are these two animals different from human beings? *They are not mammals of the highest order, they cannot walk upright, etc.*

MODULE 5, NUMBER 2 - BICYCLE GEARS

Teacher Activity Sheet

Overview

In this activity, your students will take a close look at how bicycle gears work and discover the ways in which these gears help a cyclist.

Math Skills Your Students Will Need

Measuring distances, multiplication, division, and an understanding of ratios.

Time Allotment

Two class periods.

Objectives

Your students will:

1. Have a better understanding of how different bicycle gears change the distance and the ease with which a bicycle travels with one revolution of the pedal.

2. With the aid of a chart, be able to calculate ratios between the number of pedal turns and the number of rear-wheel turns for a five- or ten-speed bicycle.

Materials Your Class Will Need

Your class will need a five- or ten-speed bicycle, measuring tape, and masking tape or chalk. Each student will need paper, a pencil, and Bicycle Gears Worksheets.

Vocabulary

gear:	a wheel with teeth, which meshes with another toothed element to change speed or direction
revolution:	one complete turn
sprocket:	a toothlike projection arranged on a wheel rim to engage (or catch on to) the links of a chain
tooth:	a small projection that is shaped like a tooth, as on a comb, saw, or gear

Self-Concept Builder

Many children of this age own a bicycle or are, at the least, very familiar with one. As they get older, they may consider buying a five- or ten-speed bike. This activity will foster an understanding of how bicycle gears operate.

Activity

1. Have one of your students bring a five- or ten-speed bike to class. Take your class out to the playground or use a hallway or gymnasium to examine the bike. Point out to the students where the different parts of the bike are that relate to gears (e.g., the large sprocket wheel, the small sprocket wheel, the drive chain).

2. Your class will observe as the owner of the bike and several other students conduct the following experiment.* Each student will record the necessary information on a sheet of paper.

   a. Have the bike's owner put the bike in its lowest gear (the chain should be positioned on a large rear sprocket and a small front sprocket). Put a piece of masking tape or draw a chalk line on the floor or ground to mark the starting point. Have the owner of the bike get on the bike, position the front wheel on the tape, and put the right pedal at its highest point. With two other students steadying the cyclist, have the person pedal forward until the right pedal has made one complete revolution. Have another student mark the floor or ground under the front wheel with tape or chalk. This distance is then measured and recorded.

   b. Have a student count the number of sprockets (teeth) on the largest sprocket wheel at the rear of the bike and also the sprockets on the smallest sprocket wheel at the front of the bike under the pedals. This information should be recorded.

   c. Have the bike owner put the bike in its highest gear and repeat step #2a. (The chain will be on a small rear sprocket and a large front sprocket.)

   d. Have a student count the number of sprockets on the smallest sprocket wheel at the rear of the bike and also count the number of sprockets on the largest sprocket wheel at the front of the bike under the pedals. This information should be recorded.

*Depending on the level of your students, you may want to have this experiment conducted several times by different students as the remainder of the class observes. Encourage discussion.

3. Have your students (alone or in small groups) work on the Bicycle Gears Worksheet. You may want to review some of the math skills they will be using before they get started.

Occupations Related to This Activity

What occupations might use an activity similar to this one? Have your students complete the career section on their Activity Sheet. After class discussion, they should add these occupations to the list:

BICYCLE MECHANIC BICYCLE RACER

AUTO MECHANIC MECHANICAL ENGINEER

Discuss the types of courses people going into these occupations should take in high school. Have your students add these courses to their Activity Sheet.

Stress that women and men can be equally successful in most careers, if they are qualified.

Suggested Independent Activities

(These suggestions appear on Student Activity Sheet.)

1. You may want to take a closer look at a bike when you get home. You can measure the distance it travels in gear (if it is a one-speed bike) or in more than one gear (if it is a three-, five-, or ten-speed bike.

2. Look around during the next couple of days to see if you can discover some other gears that help us. How do these gears differ from bicycle gears? In what ways are they the same?

MODULE 5, NUMBER 2 - BICYCLE GEARS

Student Activity Sheet

Your Name _____ Date _____

Overview

You may often ride a bicycle, but have you ever thought about how a bicycle works? In this activity, you will take a close look at how bicycle gears work and discover the ways in which gears help a cyclist.

Math Skills You Need to Remember

Measuring distances, multiplication, division, and an understanding of ratios.

Things You Will Need

Your class will need a five- or ten-speed bicycle, measuring tape, and masking tape or chalk. You will need paper, a pencil and a Bicycle Gears Worksheet.

Vocabulary

gear:	a wheel with teeth, which meshes with another toothed element to change speed or direction
revolution:	one complete turn
sprocket:	a toothlike projection arranged on a wheel rim to engage (or catch on to) the links of a chain
tooth:	a small projection that is shaped like a tooth, as on a comb, saw, or gear

When You Finish You Will Be Able To

Describe how bicycle gears help a cyclist.

Activity

1. Your teacher will discuss with your class several parts of a bicycle that relate to gears.

2. Observe the experiment that your teacher conducts along with the owner of the bike and several other students. Record all necessary information on a piece of paper.

3. Now complete your Bicycle Gears Worksheet.

Occupations Related to This Activity

(You may check the MATHCO Career Wall Charts to get more information about a career in which you are interested.)

OCCUPATIONS	SUBJECTS NEEDED IN HIGH SCHOOL

Are you interested in any of these careers? Remember, you can be anything you want to be--if you are qualified.

Men and women can do the same jobs with equal success. Can't both women and men enter each of the occupations you've listed above?

Exploring on Your Own

1. You may want to take a closer look at a bike when you get home. You can measure the distance it travels when in gear (if it is a one-speed bike) or in more than one gear (if it is a three-, five-, or ten-speed bike).

2. Look around during the next couple of days to see if you can discover some other gears that help us. How do these gears differ from bicycle gears? In what ways are they the same?

MODULE 5, NUMBER 2 - BICYCLE GEARS

Worksheet

1. In the lowest gear (gear #1), the experimental bike traveled a distance of _____ inches in one revolution.

2. In the lowest gear, there were _____ teeth on the sprocket wheel at the rear of the bike and _____ teeth on the sprocket wheel at the front of the bike under the pedals.

3. In the highest gear (gear #5 for a five-speed bike and gear #10 for a ten-speed bike), the experimental bike traveled a distance of _____ inches in one revolution.

4. In the highest gear, there were _____ teeth on the sprocket wheel at the rear of the bike and _____ teeth on the sprocket wheel at the front of the bike under the pedals.

5. Set up a ratio for Question 2. Divide the number of teeth on the front sprocket wheel by the number of teeth on the rear sprocket wheel:

   (LOW GEAR) $\frac{\text{\# ON FRONT}}{\text{\# ON REAR}}$ = _____ = _____

6. Set up the same kind of ratio for Question 4:

   (HIGH GEAR) $\frac{\text{\# ON FRONT}}{\text{\# ON REAR}}$ = _____ = _____

7. What do you notice about your answers to Questions 5 and 6 in relation to what gears they were in?

   The ratio is larger for the high gear.

8. As you increase from the lowest gear of a bike to the highest gear, what do you think the ratio of the number of sprockets on the front sprocket wheel to the number of sprockets on the rear sprocket wheel will do?

The ratio increases as you move from 1st to 2nd to 3rd gears, and so on.

What will happen to this ratio? $\frac{\text{\# ON FRONT}}{\text{\# ON REAR}}$

It continues to increase.

9. Now, divide the total number of inches traveled in the lowest gear by the total number of inches traveled in the highest gear. What is your answer? _____ (Your answer should tell you how many times farther the bike went in the highest gear.)

10. What is the relationship of the lowest gear to the distance traveled?

You move a shorter distance but the bike is easier to pedal.

11. What is the relationship of the highest gear to the distance traveled?

You move a longer distance but the bike is harder to pedal.

12. In which gear is the bike easiest to pedal? Lowest or highest?

Lowest.

13. Would you want to pedal a bike uphill in low or in high gear? Explain your answer. *In low gear, because the bike will be easier to pedal.*

14. Can someone ride a long distance and make best time (1) in high gear, (2) in low gear, or (3) in a combination of both high and low gears? Explain your answer.

A combination of both. Low gear will get the person started more smoothly and easily; high gear will keep him or her moving fast with the least amount of effort.

15. Give at least three good reasons why some bikes have more than one gear:

(1) to be used in racing, when speed is important.

(2) to be used by people traveling long distances.

(3) to be used in hilly terrain.

Now that you have a good basic understanding of how bicycle gears work, let's look at some ratio problems involving a particular five-speed bike:

Jill has a five-speed bicycle. The ratio of pedal turns for each gear of her bike is given below:

	1st gear	2nd gear	3rd gear	4th gear	5th gear
Number of pedal turns	9	4	1	3	5
Number of rear-wheel turns	14	7	2	7	14

Using this information, it is possible to figure out how many times the rear wheel of Jill's bike will turn if the pedals are turned 180 times in the first gear. You use the ratio for the first gear (9 to 14) and set the problem up in the following way:

a. FIRST GEAR RATIO $\frac{9}{14} = \frac{180}{N}$ Number of pedal turns / Number of rear-wheel turns (this is the unknown)

b. $9N = 2{,}520$ (14×180)

c. $\frac{9N}{9} = \frac{2{,}520}{9}$

d. N = 280. The rear wheel turns 280 times.

Using the same procedure as was used to figure out the problem regarding Jill's bike on the previous page, fill in the chart below with the correct information. Use the ratio of pedal turns given for Jill's bike to compute your answers.

	Gear	Number of Pedal Turns	Number of Rear-Wheel Turns
Example	1st	180	280
1.	2nd	180	*315*
2.	3rd	180	*360*
3.	4th	180	*420*
4.	5th	180	*504*
5.	1st	*9*	14
6.	2nd	*8*	14
7.	3rd	*7*	14
8.	4th	*6*	14
9.	5th	*5*	14
10.	1st	*27*	42
11.	3rd	100	*200*
12.	5th	1,000	*2,800*

MODULE 5, NUMBER 3 - LEVERS

Teacher Activity Sheet

Overview

Your students will make a lever and, through experimenting by adding weights and moving the fulcrum, will learn how this simple machine works.

Math Skills Your Students Will Need

Multiplication, division, and a knowledge of equations.

Time Allotment

One class period.

Objectives

Your students will gain knowledge and an understanding of the practical application of the scientific principle that a lever can be balanced when the fulcrum is positioned so that the weight on one end times the distance to the fulcrum is equal to the weight times the distance on the other end.

Materials Your Class Will Need

Each student will need a Levers Worksheet, paper, and a pencil. Each group will need a meter stick or yardstick, five identical empty 6-oz. cans (e.g., tomato paste cans), and a triangular block from a kindergarten room or a physics lab.*

Vocabulary

fulcrum: the support on which a lever rests or turns

lever: a machine that consists of a bar or board that rests or turns on a support (fulcrum); a lever is one of the six simple machines for performing work

work: moving an object through a distance

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*NOTE: This triangular block will be used for the fulcrum and should have a slightly tapered edge (for balancing the stick on) instead of being razor-sharp. (Galvanized sheet metal with a 90° bend may be substituted for the triangular block.)

Self-Concept Builder

This activity uses simple math skills. The experiment can be done as a group activity or in front of a whole class.

Activity

1. This experiment can be done as an entire class or in groups of three to six students.

2. Place one tomato paste can on each end of the meter stick. Move the fulcrum (the triangular block) underneath until it balances. Check the distance from the fulcrum to each end. Multiply each distance by the weight of the can on that side of the fulcrum. They should be nearly equal.

3. Place two cans on one end and one can on the other end of the meter stick. Again move the fulcrum until the stick balances. Ask each group what it has discovered.

4. Now, use three cans on one end, and two on the other. Have each group estimate where the fulcrum will balance the lever before the students move it. How close were they to this estimate? The answer might not be exact, but it should be close.

5. Have the entire class try to decide upon a formula to use when working lever problems.

6. Each student will complete the Levers Worksheet.

Occupations Related to This Activity

What occupations might use an activity similar to this one? Have your students complete the career section on their Activity Sheet. After class discussion, they should add these occupations to the list:

PHYSICIST	DOCKWORKER	ACROBAT
SCIENCE TEACHER	SALESPERSON WHO SUPPLIES AND STOCKS STORE SHELVES	

Discuss the types of courses people going into these occupations should take in high school. Have your students add these courses to their Activity Sheet.

Stress that women and men can be equally successful in most careers, if they are qualified.

Suggested Independent Activities

(These suggestions appear on Student Activity Sheet.)

1. Design a catapult, which is a leverlike instrument.
2. Use a seesaw in a local playground to conduct some lever experiments.
3. Investigate various classes of levers.

MODULE 5, NUMBER 3 - LEVERS

Student Activity Sheet

Your Name _____ Date _____

Overview

In this activity, you will discover how a lever works and how it can be balanced.

Math Skills You Need to Remember

Multiplication, division, and a knowledge of equations.

Things You Will Need

Each group will need a meter stick or yardstick, five identical empty 6-oz. cans (e.g., tomato paste cans), a triangular block (from a kindergarten room or a physics lab), their Levers Worksheet, paper, and pencils.

Vocabulary

fulcrum: a support on which a lever rests or turns

lever: a machine that consists of a bar or board that rests or turns on a support (fulcrum); a lever is one of the six simple machines for performing work

work: moving an object through a distance

When You Finish You Will Be Able To

Balance a lever with uneven weights on either end, and solve simple lever problems.

Activity

1. With your group, place one tomato paste can on each end of a meter stick. Move the fulcrum underneath the stick until it balances. Check the distance from the fulcrum to each end. Multiply each distance by the weight of the can on that side of the fulcrum.

2. Now, place two cans on one end and one can on the other. Again move the fulcrum and multiply as you did above. What did you find out?

3. This time, use three cans on one end, and two on the other. Estimate where the fulcrum will balance the lever before you move it. How close were you to your estimate? The answer might not be exact, but it should be close.

4. Can you and your classmates come up with a formula that will help you solve lever problems?

5. Complete your Levers Worksheet.

Occupations Related to This Activity

(You may check the MATHCO Career Wall Charts to get more information about a career in which you are interested.)

OCCUPATIONS	SUBJECTS NEEDED IN HIGH SCHOOL
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Are you interested in any of these careers? Remember, you can be anything you want to be--if you are qualified.

Men and women can do the same jobs with equal success. Can't both women and men enter each of the occupations you've listed above?

Exploring on Your Own

1. Design a catapult, which is a leverlike instrument.

2. Use a seesaw in a local playground to conduct some lever experiments.

3. Investigate various classes of levers.

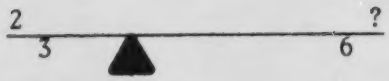
MODULE 5, NUMBER 3 - LEVERS

Worksheet

Using the information given, figure the weights of the objects in the following problems:

1.

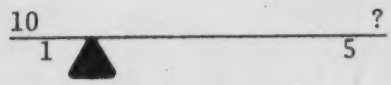
1. ? = 2

2. 

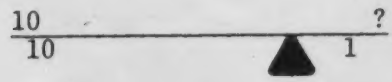
2. ? = 1

3.

3. ? = 4

4. 

4. ? = 2

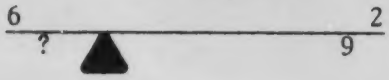
5. 

5. ? = 100

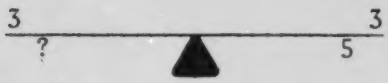
Using the information given, figure the missing distances on the levers below:

1.

1. ? = 8

2. 

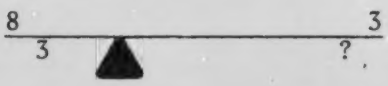
2. ? = 3

3. 

3. ? = 5

4.

4. ? = 12

5. 

5. ? = 8

Describe what you have learned about levers in this MATHCO activity:

Answers will vary; in general, students should describe the relationships between weights and distances on a lever while also mentioning the function of the fulcrum.

MODULE 5, NUMBER 4 - NOISE

Teacher Activity Sheet

Overview

Your students will graph noises and noise level data, and they will discover which levels might cause damage to their hearing.

Math Skills Your Students Will Need

Making and understanding a simple bar graph.

Time Allotment

One class period.

Objectives

Your students will:

1. Complete a bar graph using given data.
2. Discover what noise levels might affect their hearing.

Materials Your Class Will Need

Graph paper, Noise Information Sheets, rulers, and pencils.
(Optional: colored markers or pens.)

Vocabulary

audiologist: a scientist who studies and measures a person's ability to hear different levels of sound

decibel: a unit used to measure the relative intensity of sound

Self-Concept Builder

By including rock bands in the supplied data, this activity should be of interest to most students this age.

Activity

1. With your students, go over an example of a bar graph, emphasizing the necessary items of a graph (e.g., the title, the horizontal and vertical headings). Most math books contain sections on making and understanding graphs. If those in use do not, use a social studies text, a magazine, or other materials of your choice.

2. Have your students use their Noise Information Sheet to make a bar graph showing the decibel levels of common noises.

3. Your students should indicate on their bar graphs:

   a. The decibel level at which total deafness occurs.

   b. The decibel level that can cause a loss of hearing when a person is exposed to the noise for more than five hours a day over a period of time.

4. Discuss with your class how this information might be important to them both now and in the future.

Occupations Related to This Activity

What occupations might use an activity similar to this one? Have your students complete the career section on their Activity Sheet. After class discussion, they should add these occupations to the list:

AUDIOLOGIST	PLANT SAFETY ENGINEER
AUDIOMETRIST	PHYSICIAN
SPEECH PATHOLOGIST	MUSICIAN

Discuss the types of courses people going into these occupations should take in high school. Have your students add these courses to their Activity Sheet.

Stress that women and men can be equally successful in most careers, if they are qualified.

Suggested Independent Activities

(These suggestions appear on the Student Activity Sheet.)

Investigate what your city and state are doing about noise pollution and report your results to the rest of your class.

MODULE 5, NUMBER 4 - NOISE

Student Activity Sheet

Your Name _____ Date _____

Overview

In this activity, you will study noise levels and discover which levels can damage your hearing.

Math Skills You Need to Remember

Making and understanding a simple bar graph.

Things You Will Need

Graph paper, Noise Information Sheet, ruler, and a pencil. (Optional: colored markers or pens.)

Vocabulary

audiologist: a scientist who studies and measures a person's ability to hear different levels of sound

decibel: a unit used to measure the relative intensity of sound

When You Finish You Will Be Able To

Identify those sounds that will damage your hearing due to their decibel level and construct a bar graph using data that are given to you.

Activity

1. Use your Noise Information Sheet to make a bar graph showing the decibel levels of common noises.

2. Make sure you read all of the information on your Noise Information Sheet before beginning your bar graph.

3. Indicate on your bar graph the decibel level at which total deafness occurs. Also indicate the decibel level that can cause hearing loss when a person is exposed to it for more than five hours a day over a period of time.

4. Be prepared to discuss with your class how this information might be important to all of you now and in the future.

Occupations Related to This Activity

(You may check the MATHCO Career Wall Charts to get more information about a career in which you are interested.)

OCCUPATIONS	SUBJECTS NEEDED IN HIGH SCHOOL
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Are you interested in any of these careers? Remember, you can be anything you want to be--if you are qualified.

Men and women can do the same jobs with equal success. Can't both women and men enter each of the occupations you've listed above?

Exploring on Your Own

Investigate what your city and state are doing about noise pollution and report your results to the rest of your class.

MODULE 5, NUMBER 4 - NOISE

Information Sheet

Use these facts to make your bar graph:

NOISE	DECIBELS
Army cannon	160
Breathing	10
Garbage disposal (with bones)	100
House	30
Jet plane	130
New York City	90
Residential neighborhood	40
Rock band	120
Silence	0
Traffic	70
Vacuum cleaner	80

"Boilermaker's Deafness"

"Boilermaker's deafness" is permanent hearing loss caused by being exposed to loud noises every day for a period of years. Recently, both the state and federal governments have tried to help people who work in areas where there are extremely high noise levels. Because a cannon with a 160-decibel noise level can rupture the eardrum and cause instant deafness, soldiers now wear ear protection. It is believed that no one should be exposed to noise levels over 85 decibels for more than five hours a day. In one study, it was found that teenagers who listened constantly to loud rock music had hearing losses commonly found in elderly people.

MODULE 5, NUMBER 5 - LUNG CAPACITY

Teacher Activity Sheet

Overview

You and your students will make a device that will measure the amount of air in their lungs. They will then compare their lung capacities and construct a histogram to show their findings.

Math Skills Your Students Will Need

Measuring, averaging, and charting.

Time Allotment

Two class periods.

Objectives

Your students will:

1. Make a device for measuring lung capacity.
2. Calculate their own lung capacities.
3. Find the average lung capacity of the members of the class.
4. Discover that there is a large variation in lung capacities.

Materials Your Class Will Need

Your class will need a two-quart (or two-liter) STRONG plastic container with a cap (a soft drink container works well), a measuring cup, plastic tubing (such as that used in fish tanks), and a dishpan or sink. Each student will need a drinking straw, a pencil, a ruler, paper, and a Lung Capacity Worksheet.

Vocabulary

capacity: all that can be contained in something; the volume

displace: to move something from its usual place

exhale: to breathe out

histogram: a representation on a graph of how frequently an event occurs within a group and how that event is distributed within that group

invert: to turn upside down (or inside out)

Self-Concept Builder

This experiment is both easy and fun to do. Working as an entire class, your students will discover something about themselves as individuals and as a group.

Activity

1. Review the vocabulary words with your students and discuss with them the terms "lung capacity" and "histogram." Explain how and why histograms are used.

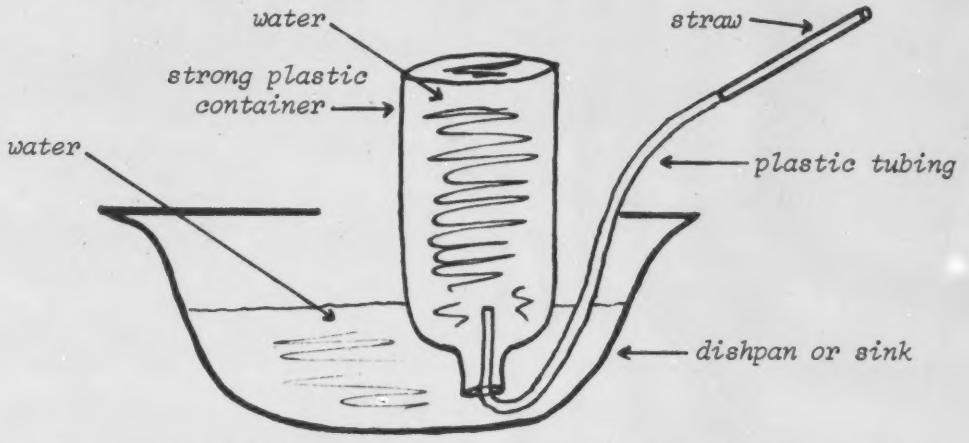
2. With your class, construct a device for measuring lung capacity:

   a. One student partially fills a sink or dishpan with water.

   b. Another student fills a strong plastic container to the rim with water and caps it. (A push-on cap works better than the screw-on lid of some plastic bottles and should be used, if possible.)

   c. The bottle is inverted and placed in the sink or dishpan. The rim and neck of the bottle should be covered by at least two to three inches of water. One student holds the bottle in place while another student carefully removes the cap and puts one end of the plastic tubing into the bottle (keeping it submerged at all times).

   d. Diagram of lung capacity device:



3. After a drinking straw has been inserted into the end of the plastic tubing, one student takes a big breath of air and exhales into the tubing, while another student holds the bottle in place. When the student has exhaled as much air as possible from his or her lungs, a third student caps the bottle while it is still under water. The bottle is then removed from the sink or dishpan.

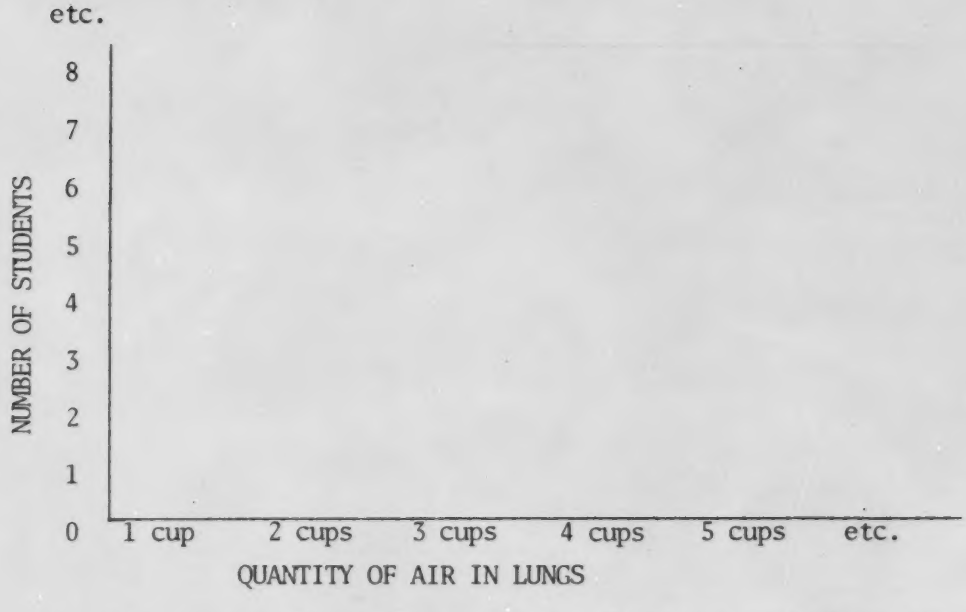
4. The student who has just exhaled should then carefully refill the bottle with water. She or he should use a measuring cup and carefully measure the amount of water poured back into the bottle. This amount is equal in volume to the student's lung capacity. He or she should make note of his or her lung capacity on his or her Activity Sheet.

5. Repeat the above process until each student has had a turn.

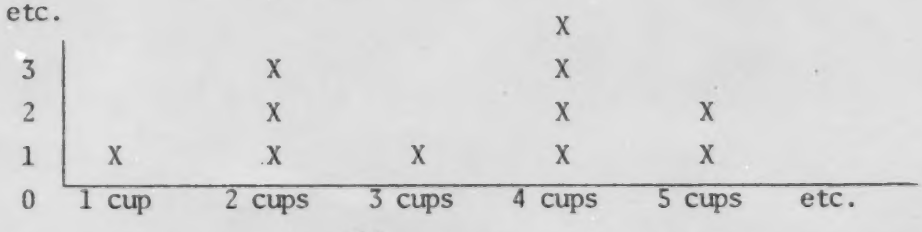
6. Figure out together the average lung capacity of the class.

7. Together, as a class, construct a histogram representing the lung capacity of the group:

   a. On the chalkboard, draw an X axis and a Y axis and label them as follows:



   b. Have each student come to the board and put an X above the quantity of air she or he blew into the bottle. If a student has already placed an X on a particular quantity, the next student having the same capacity puts his or her X above it. This allows each student to see where she or he fits in the class. Example:



c. Your students are now ready to reconstruct the lung capacity histogram on their Lung Capacity Worksheets.

8. Discuss with the students what the reasons might be for variations in lung capacities within the class. How might they be affected by their particular lung capacities?

Occupations Related to This Activity

What occupations might use an activity similar to this one? Have your students complete the career section on their Activity Sheet. After class discussion, they should add these occupations to the list:

DOCTOR	NURSE
PARAMEDIC	MEDICAL TECHNICIAN
MEDICAL RESEARCHER	LUNG ASSOCIATION EMPLOYEE

Discuss the types of courses people going into these occupations should take in high school. Have your students add these courses to their Activity Sheet.

Stress that men and women can be equally successful in most careers, if they are qualified.

Suggested Independent Activities

(These suggestions appear on Student Activity Sheet.)

You may wish to make a comparative study of other groups of people's lung capacities. Here are some groups you might try:

joggers	vs.	nonjoggers
older students	vs.	younger students
tuba players	vs.	drummers
nonsmoking adults	vs.	smoking adults

Graph your results and try to determine what might account for the variations you may find in their lung capacities. Can you think of any other groups that would be interesting to compare?

MODULE 5, NUMBER 5 - LUNG CAPACITY

Student Activity Sheet

Your Name _____ Date _____

Overview

In this activity, you will measure the amount of air your lungs can hold and graph the lung capacities of you and your classmates on a histogram.

Math Skills You Need to Remember

Measuring, averaging, and charting.

Things You Will Need

You will need some paper, a pencil, a ruler, a drinking straw, and a Lung Capacity Worksheet. Your class will need a two-quart (or two-liter) strong plastic container with a cap, a measuring cup, plastic tubing, and a dish-pan or sink.

Vocabulary

capacity:	all that can be contained in something; the volume
displace:	to move something from its usual place
exhale:	to breathe out
histogram:	a representation on a graph of how frequently an event occurs within a group and how that event is distributed within that group
invert:	to turn upside down (or inside out)

When You Finish You Will Be Able To

1. Make an instrument that measures the amount of air in a person's lungs (his or her lung capacity).
2. Find the average lung capacity of the members of your class.
3. See the variations in lung capacity among your classmates.
4. Make a histogram using the data collected from your experiment.

Activity

1. Your class will first discuss the meaning of the terms "lung capacity" and "histogram." You will be discussing how and why histograms are used.

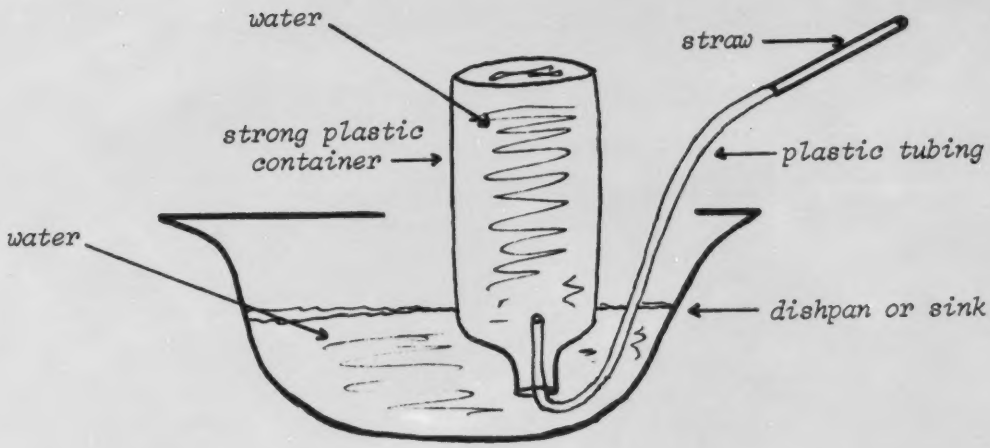
2. You and your teacher will construct a device to measure lung capacity:

   a. One student partially fills a sink or dishpan with water.

   b. Another student fills a plastic bottle to the rim with water. The bottle is then capped.

   c. The bottle is inverted and placed in the sink or dishpan. One student holds the bottle in place while someone else carefully takes the cap off of it. Keeping the bottle submerged, the second student inserts one end of the plastic tubing into the bottle.

   d. Diagram of lung capacity measuring device:



3. While a student is holding the bottle in place, one of your classmates will take a big breath of air and exhale, blowing all of his or her breath into the other end of the plastic tubing. The bottle is then capped while it is still under water. The bottle cannot be tipped. It is then removed from the sink or dishpan.

4. The air the student blew out of his or her lungs has displaced some of the water in the bottle. The bottle must now be refilled and the water needed to refill it should be measured carefully, using the measuring cup. The amount of water it takes to refill the bottle is equal in volume to the person's lung capacity--and the student needs to record accurately his or her lung capacity measurement.

5. The tube is now cleaned off and a new straw inserted into its end. Each student in your class will get a chance to discover his or her lung capacity. When it's your turn, be sure to keep a record of your lung capacity.

   Your lung capacity: _____

6. When everyone in your class has had his or her turn and has recorded his or her lung capacity, your class will find the average lung capacity of the class.

   Class average lung capacity: _____

   How does your lung capacity compare with the class average?

   _____

   _____

7. Now, using all of the information you have collected, your teacher and class will make a histogram on the chalkboard. After you are sure you understand how a histogram is made, use your Lung Capacity Worksheet to construct your own Lung Capacity Histogram.

8. Be prepared to discuss with your class those reasons you can think of for variations in lung capacities within your class. How are <u>you</u> affected by <u>your own</u> lung capacity?

   _____

   _____

   _____

Occupations Related to This Activity

(You may check the MATHCO Career Wall Charts to get more information about a career in which you are interested.)

OCCUPATIONS	SUBJECTS NEEDED IN HIGH SCHOOL
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Are you interested in any of these careers? Remember, you can be anything you want to be--if you are qualified.

Men and women can do the same jobs with equal success. Can't both women and men enter each of the occupations you've listed above?

Exploring on Your Own

You may wish to make a comparative study of other groups of people's lung capacities. Here are some groups you might try:

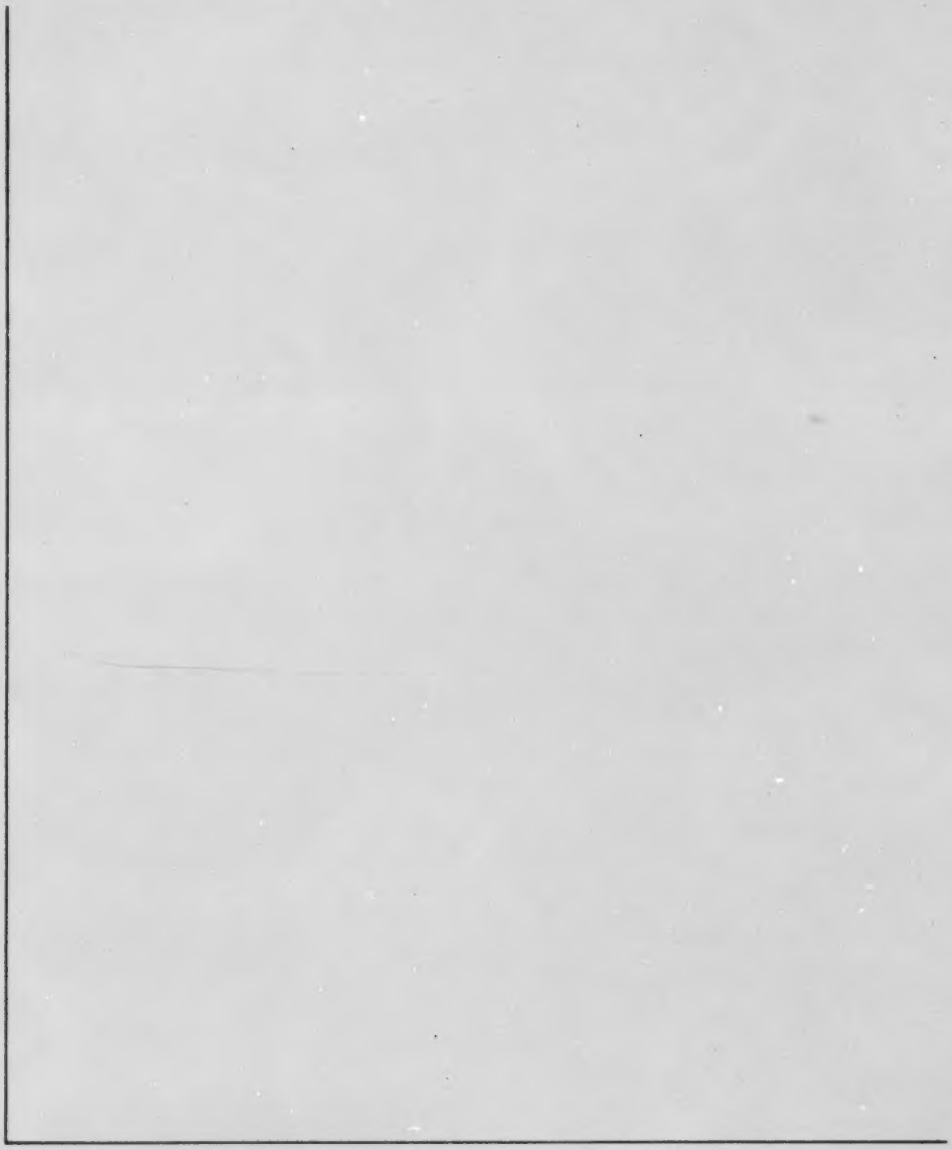
joggers	vs.	nonjoggers
older students	vs.	younger students
tuba players	vs.	drummers
nonsmoking adults	vs.	smoking adults

Graph your results and try to determine what might account for the variations you may find in their lung capacities. Can you think of any other groups that would be interesting to compare?

MODULE 5, NUMBER 5 - LUNG CAPACITY

Worksheet

Use the information your class has gathered to construct your own histogram below. Use your ruler to make even divisions on the sides of the graph, label all parts of the histogram, and think up a good title for your histogram.



MODULE 5, NUMBER 6 - ARCHAEOLOGICAL DIG

Teacher Activity Sheet

Overview

Your students, in groups, will create "archaeological digs." They will research or invent civilizations, create artifacts, and bury them. Each group will excavate and chart a "dig" that another group has created.

Math Skills Your Students Will Need

Division, working with a grid, and finding the area of a space, given its dimensions.

Time Allotment

Four class periods.

Objectives

Your students will create an archaeological dig and graph their findings on a grid.

Materials Your Class Will Need

Your class will need a garden plot or long, shallow boxes (e.g., long suit boxes), aluminum foil, dirt, modeling clay, reference materials, string, tape, spoons or shovels, paper, pencils, and yardsticks or meter sticks.

Vocabulary

archaeology:	the scientific study of the lives of ancient peoples, as by excavation of ancient cities, etc.
artifact:	an object made by humans, such as a primitive tool, a clay pot, etc.
decipher:	to convert from a code to a familiar language
excavate:	to unearth; to dig out
grid:	a network of uniformly spaced lines used to locate points

Self-Concept Builder

Working in groups, all students will get involved in this activity and have an opportunity to use their creative abilities.

Activity

1. Once you have decided how you want to group your class, made sure the groups are well separated, so that secrecy can be maintained. Emphasize that secrecy will mean success.

2. The first period is spent researching or inventing the civilization from which each group will bury artifacts. A trip to the library may be helpful in order to allow your students to do some research about civilizations of the past or present.

3. Have your students make their artifacts. Modeling clay can be used for some artifacts. Remind your students to make the clay artifacts thick enough not to crumble when they dry. Aluminum foil makes coins and weapons. Codes can be written on paper for deciphering. Have your students decide upon some sort of plan for the actual burying of the artifacts (e.g., the artifacts may be buried in a one-dimensional dig, or they may be buried in a multidimensional dig where objects are found on several levels).

4. Next, have your students bury their artifacts. They should record where their artifacts are hidden. One group of students will give their buried artifacts to another group, and will be given a box of artifacts from another group to excavate. If you are working with a garden plot and two different classes, one class buries its artifacts in one period and the other class excavates during its class period.

5. When the groups have exchanged boxes, they should determine the surface area of the box they are excavating. The area of the box should be divided as closely as possible by the number of students in the group. With string and tape, the divisions should be marked on the box so that each student has his or her own area in which to dig.

6. On paper, your students should make a grid that exactly corresponds to the strings on the box their group is excavating.

7. Each student digs in her or his rectangle or square with a spoon. As an artifact is uncovered, the student should draw or write what the artifact is on the corresponding square on the group's grid.

8. When everything has been uncovered, the group tries to determine which civilization the other group chose or invented, on the basis of the artifacts which have been found.

Occupations Related to This Activity

What occupations might use an activity similar to this one? Have your students complete the career section on their Activity Sheet. After class discussion, they should add these occupations to the list:

ARCHAEOLOGIST
ETHNOGRAPHER
PHYSICAL ANTHROPOLOGIST
SOIL SCIENTIST

Discuss the types of courses people going into these occupations should take in high school. Have your students add these courses to their Activity Sheet.

Stress that men and women can be equally successful in most careers, if they are qualified.

Suggested Independent Activities

(These suggestions appear on Student Activity Sheet.)

1. Read some books that tell of the findings at Pompeii, Italy; at Williamsburg, Virginia; or in your own home state.

2. Visit a museum or invite a local museum specialist to come and talk to your class.

MODULE 5, NUMBER 6 - ARCHAEOLOGICAL DIG

Student Activity Sheet

Your Name _____ Date _____

Overview

In this activity, you and your class will work in groups. Each group will study or invent a civilization, make artifacts from that civilization, and bury the artifacts. Your group will give a box containing your buried artifacts to another group to excavate while you help to excavate the artifacts that another group has buried.

Math Skills You Need to Remember

Division, working with a grid, and finding the area of a space, given its dimensions.

Things You Will Need

Your class will need a garden plot or long, shallow boxes (e.g., long suit boxes), aluminim foil, dirt, modeling clay, reference materials, string, tape, spoons or shovels, paper, pencils, and yardsticks or meter sticks.

Vocabulary

archaeology:	the scientific study of the lives of ancient peoples, as by excavation of ancient cities, etc.
artifact:	an object made by humans, such as a primitive tool, a clay pot, etc.
decipher:	to convert from a code to a familiar language
excavate:	to unearth; to dig out
grid:	a network of uniformly spaced lines used to locate points

When You Finish You Will Be Able To

Understand and describe some of the processes that scientists use to discover and describe the lives of people who lived long ago.

Activity

1. Your teacher will divide you into groups. You must be very secretive. Remain loyal to your group.

2. In the first period of this activity, study or invent a civilization from which to make and bury artifacts. (The encyclopedia is an excellent reference.)

3. Make the artifacts out of modeling clay. Be sure to make them thick enough not to crumble when they dry. Aluminum foil makes great coins and weapons. You can write codes to be deciphered on paper. Decide with your group the plan for burying your artifacts. You can bury them in a one-dimensional plan, or in a multidimensional plan with several layers of artifacts.

4. Bury your artifacts. Record where your group's artifacts are buried. Give your box to another group, which will give its box to your group.

5. When you get the box from the other group, measure the surface area. Divide the area as closely as possible by the number of students in your group. With string and tape, mark these divisions on the box so that each student in your group has his or her own area in which to dig.

6. On a piece of paper, draw a grid that exactly corresponds to the strings on the box. Designate each person's area on the grid.

7. Taking turns, dig carefully in your rectangle or square with a spoon. When you find an artifact, record it on the corresponding rectangle on the grid you have drawn. You may either write down the name of the artifact or draw a picture of it.

8. When your group has uncovered everything, try to determine which civilization you have excavated. In what way was the other group's civilization different from your group's civilization?

Occupations Related to This Activity

(You may check the MATHCO Career Wall Charts to get more information about a career in which you are interested.)

OCCUPATIONS	SUBJECTS NEEDED IN HIGH SCHOOL

Are you interested in any of these careers? Remember, you can be anything you want to be--if you are qualified.

Women and men can do the same jobs with equal success. Can't both men and women enter each of the occupations you've listed above?

Exploring on Your Own

1. Read some books that tell of the findings at Pompeii, Italy; at Williamsburg, Virginia; or in your own home state.

2. Visit a museum or invite a local museum specialist to come and talk to your class.

MODULE 5, NUMBER 7 - SILLY PULLEY

Teacher Activity Sheet

Overview

An unusual device is used to demonstrate how one student can, with the help of this very simple machine, have a strength advantage over two other students. From this experiment, your students will go on to learn more about pulleys and how they work.

Math Skills Your Students Will Need

Multiplication and division of simple numbers.

Time Allotment

One class period.

Objectives

Your students will:

1. Discover that a pulley can offer mechanical advantage.
2. Compute problems involving pulleys.

Materials Your Class Will Need

Your class will need two broomsticks or thick dowels and a 12-foot length of strong clothesline or rope. Each student will need a Silly Pulley Worksheet and a pencil.

Vocabulary

effort:	the force used to move an object
load:	any object to be moved or lifted
pulley:	a wheel that can change the direction of a force, reduce a force, or do both
supporting ropes:	the ropes that are attached to a load

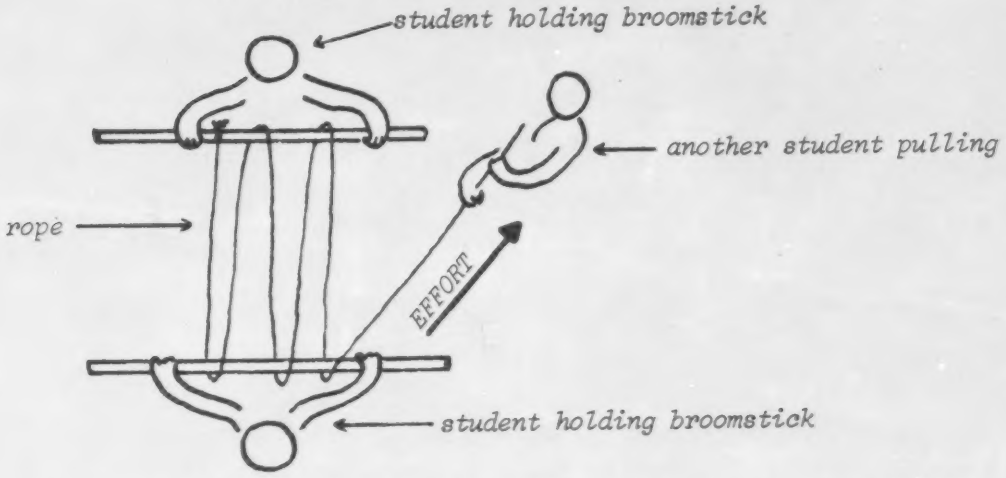
Self-Concept Builder

The experimental part of this activity allows a single student to overpower two of his or her classmates . . . to the great enjoyment of that person and the rest of the class!

Activity

1. Two students will each grasp a broomstick (or dowel) with both hands and stand several feet apart. Tie one end of the clothesline (or rope) to one of the sticks and wrap it several times around both sticks. Ask another student to pull on the loose end of the rope while the two holding the sticks try to keep them apart.

BIRD'S-EYE VIEW OF THIS ACTIVITY



2. Try this activity several more times, experimenting with the number of times the rope is wrapped around the sticks and with the relative sizes of the students exerting the effort.

3. Discuss the vocabulary words with your students and the question, "What does the wrapping of the rope around the sticks do to the effort the pulling student must use?"

4. Your students will now read more about pulleys on their Silly Pulley Worksheet and will complete several problems involving pulleys.

Occupations Related to This Activity

What occupations might use an activity similar to this one? Have your students complete the career section on their Activity Sheet. After class discussion, they should add these occupations to the list:

PHYSICIST	SCIENCE TEACHER
ENGINEER	MECHANIC
FURNITURE MOVER	SHIPYARD WORKER/DOCKWORKER

Discuss the types of courses people going into these occupations should take in high school. Have your students add these courses to their Activity Sheet.

Stress that women and men can be equally successful in most careers, if they are qualified.

Suggested Independent Activities

(These suggestions appear on Student Activity Sheet.)

You might want to get some metal pulleys from a hardware store and try some of the experiments on your Silly Pulley Worksheet. You could also use a spring scale to try these experiments.

MODULE 5, NUMBER 7 - SILLY PULLEY

Student Activity Sheet

Your Name _____ Date _____

Overview

In this activity, you will discover how a pulley can be used by you to have a mechanical strength advantage over two of your classmates in a "tug-of-war."

Math Skills You Need to Remember

Multiplication and division of simple numbers.

Things You Will Need

You will need a Silly Pulley Worksheet and a pencil. Your class will need two broomsticks or thick dowels and a 12-foot length of strong clothesline or rope.

Vocabulary

effort:	the force used to move an object
load:	any object to be moved or lifted
pulley:	a wheel that can change the direction of a force, reduce a force, or do both
supporting ropes:	the ropes that are attached to a load

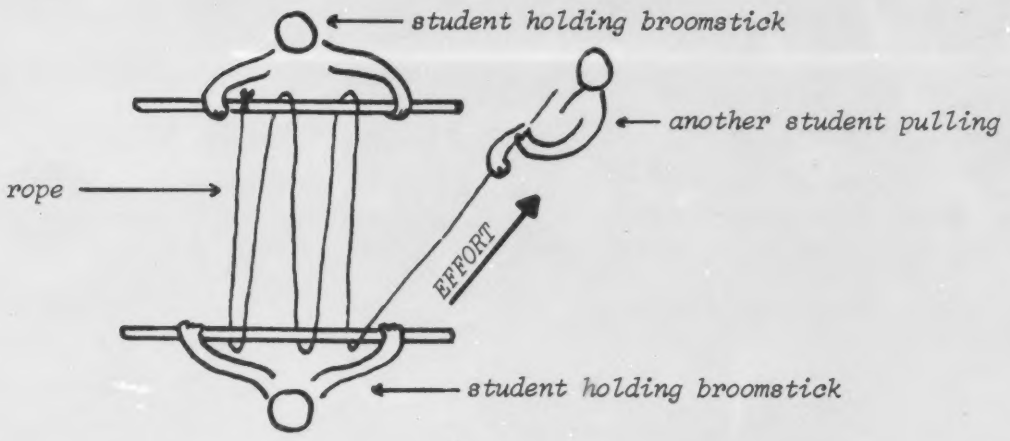
When You Finish You Will Be Able To

Apply the principle that pulleys can reduce effort and compute problems involving pulleys.

Activity

1. Two of your classmates will each grasp a broomstick (or dowel) with both hands and stand several feet apart. One end of the clothesline (or rope) is tied to one of the sticks and wrapped several times around both sticks. Another of your classmates will pull on the loose end of the rope while the two holding the sticks try to keep them apart.

BIRD'S-EYE VIEW OF THIS ACTIVITY



2. This experiment will be done several times with different students participating and with the rope being wound around the sticks various numbers of times. You may volunteer to hold the sticks or to pull on the rope. Do your best! Watch this experiment carefully and be prepared to discuss with your class what you have observed.

3. Complete your Silly Pulley Worksheet. This Worksheet will give you some more information about pulleys and some problems to solve.

Occupations Related to This Activity

(You may check the MATHCO Career Wall Charts to get more information about a career in which you are interested.)

OCCUPATIONS	SUBJECTS NEEDED IN HIGH SCHOOL

Are you interested in any of these careers? Remember, you can be anything you want to be--if you are qualified.

Women and men can do the same jobs with equal success. Can't both men and women enter each of the occupations you've listed above?

Exploring on Your Own

You might want to get some metal pulleys from a hardware store and try some of the experiments on your Silly Pulley Worksheet. You could also use a spring scale to try these experiments.

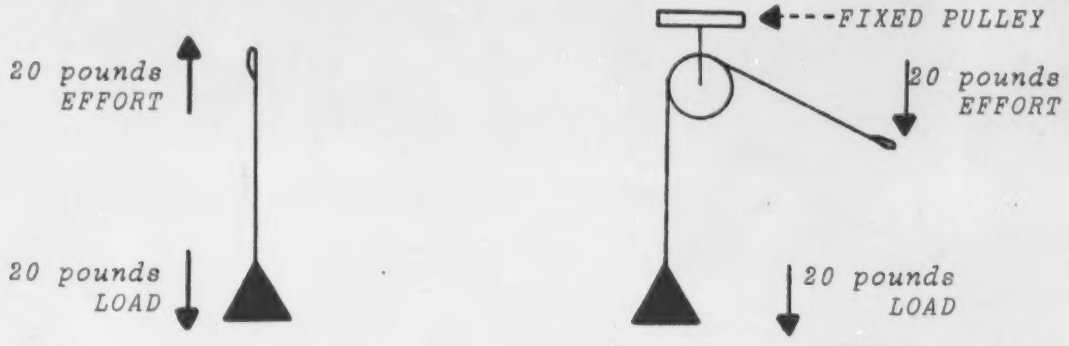
MODULE 5, NUMBER 7 - SILLY PULLEY

Worksheet

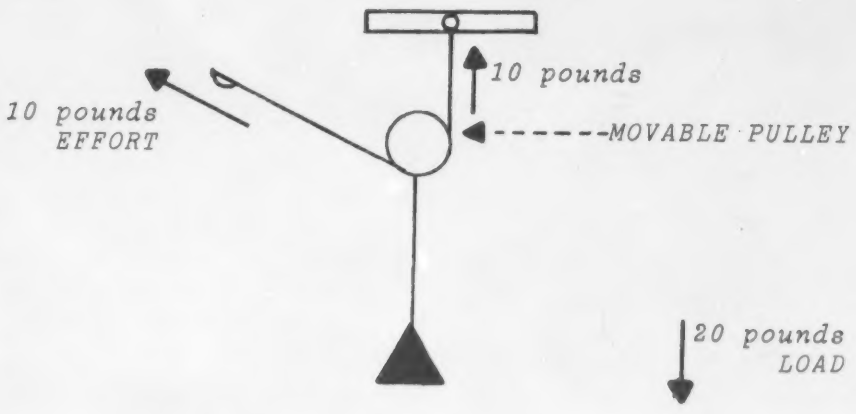
PART I of this Worksheet will give you some additional information about pulleys. Read this section carefully. PART II consists of several pulley problems for you to solve.

PART I. How and Why Some Pulleys Are Used

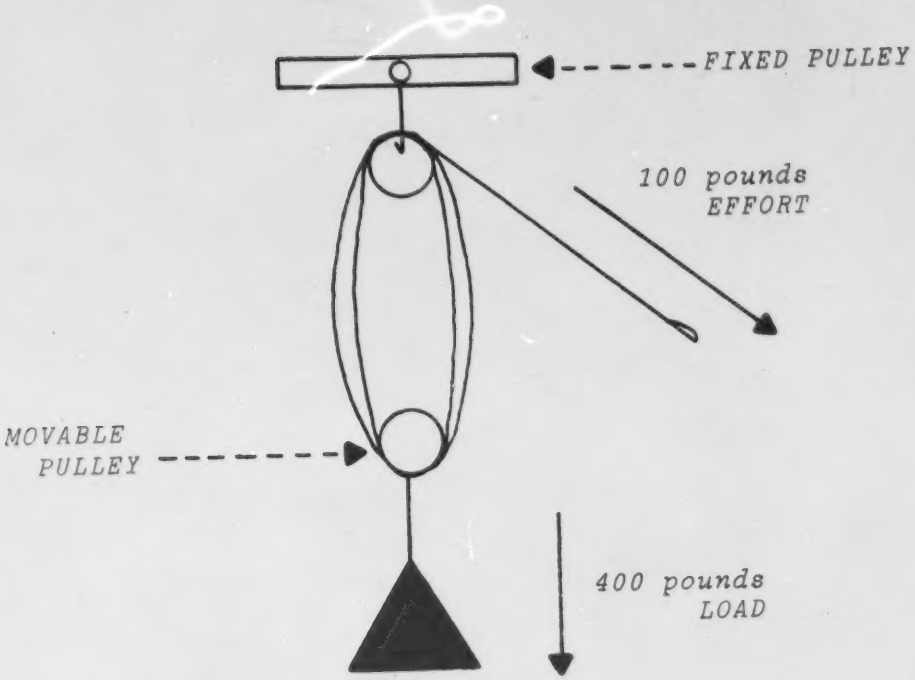
Some pulleys make work easier by changing the direction of the effort needed to move the load. For example, lifting a 20-pound weight on a spring balance differs from lifting the same weight using a fixed pulley. You still need a 20-pound force to move the load in both cases, BUT it is much easier using the pulley. Instead of lifting up you are pulling down and you have your own body weight to help.



Some pulleys make work easier by reducing the force needed to move the load. For example, a movable pulley uses two strands of rope in the lifting process. This reduces the effort needed because the load is divided between two ropes. To lift a 20-pound weight, only 10 pounds of effort is needed.



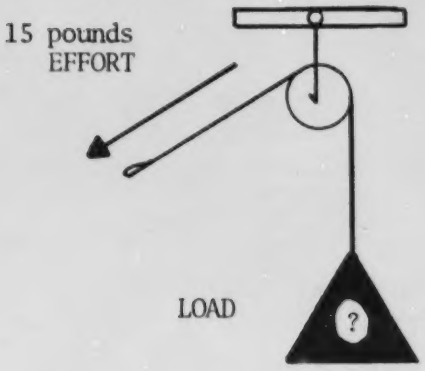
Teams of pulleys, some fixed and some movable, enable us to lift very heavy loads with small amounts of effort. The effort saved depends upon the number of ropes attached to the movable pulley that holds the load. For example, an effort of only 100 pounds is needed to raise a 400-pound weight when four strands of rope are used.



PART II. Some Pulley Problems for You to Try

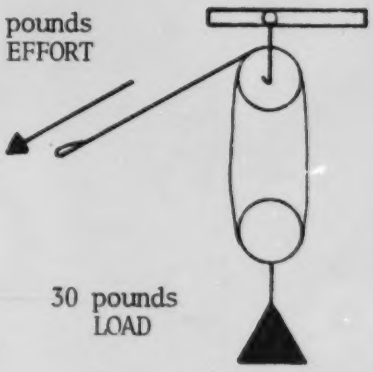
REMEMBER: The load that a pulley can lift is found by counting the supporting ropes and multiplying their number by the effort used in pulling. Count all of the rope strands EXCEPT the one pulled down on.

1.



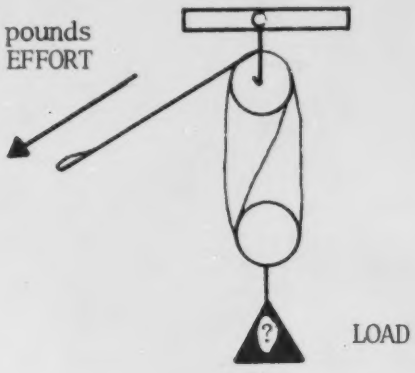
LOAD = *15 pounds*

2.



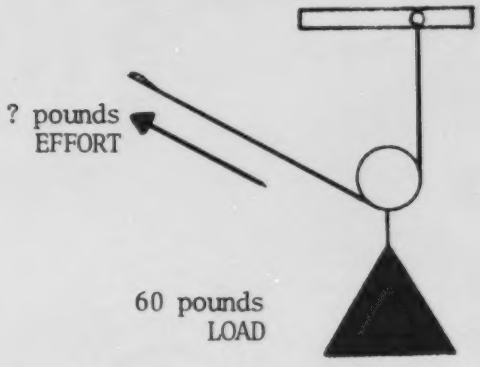
EFFORT = *15 pounds*

3.



LOAD = *60 pounds*

4.



EFFORT = *30 pounds*

5. A flagpole is a good example of a pulley that just changes the direction of the force needed to lift the load. Why is a pulley a big help on a flagpole?

Because a flag's flying position is very high in the air. The pulley assists people in maneuvering a flag to great heights with little effort. (The weight of the load is not a critical factor here.)

MODULE 5, NUMBER 8 - PROPER MEASUREMENT

Teacher Activity Sheet

Overview

Your students will discover the significance of commonly agreed upon measuring tools and measurement systems. They will use parts of their bodies to measure various objects and sections of the classroom.

Math Skills Your Students Will Need

Measuring and multiplication of large (astronomical) numbers.

Time Allotment

One class period and possibly homework.

Objectives

Your students will:

1. Discover the necessity for using a properly identified system of measurement and measuring tools.
2. Discover how the astronomical unit "light years" is of importance to scientists.

Materials Your Class Will Need

Proper Measurement Worksheet, paper, and pencils.

Vocabulary

light year:	the number of miles light travels in one year
speed of light:	186,000 miles per second

Self-Concept Builder

This activity is designed to let students make some discoveries while having fun. Working in groups enables them to discuss all of their findings and to compare notes.

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Activity

1. Do not explain initially what students will be doing!
2. Place your students in groups of two and ask each group to choose one of the following parts of the body to use for measuring: foot, hand in a spread-out position, forearm, or thumb, from the first digit to the end.
3. Assign random objects or areas in the classroom to be measured by the groups (e.g., length of room, depth of desk).
4. After your students have measured, place the results on the board and discuss which parts of the body would have been best for measuring each of the objects. Ask your students if they can change the results to one common unit of measure, such as feet, inches, centimeters, or meters.
5. Introduce the terms "speed of light" and "light year."
6. Discuss the need for common units as well as appropriate units of measure.
7. Pass out the Proper Measurement Worksheet and have your students work the problems.
8. This may be a good opportunity for a discussion of the pros and cons of our nation's "going metric."

Occupations Related to This Activity

What occupations might use an activity similar to this one? Have your students complete the career section on their Activity Sheet. After class discussion, they should add these occupations to the list:

ASTRONOMER	ARCHITECT
ENGINEER	BUILDING TRADE OCCUPATIONS
ASTRONAUT	CLOTHING MANUFACTURER
SCIENCE FICTION WRITER	ATHLETE

Discuss the types of courses people going into these occupations should take in high school. Have your students add these courses to their Activity Sheet.

Stress that women and men can be equally successful in most careers, if they are qualified.

Suggested Independent Activities

(These suggestions appear on Student Activity Sheet.)

You may want to check in the encyclopedia to discover where the following units of measure originated: foot, yard, stone.

MODULE 5, NUMBER 8 - PROPER MEASUREMENT

Student Activity Sheet

Your Name _____ Date _____

Overview

In this activity, you will discover the importance of using commonly agreed upon tools and units for measuring.

Math Skills You Need to Remember

Measuring and multiplication of large (astronomical) numbers.

Things You Will Need

Proper Measurement Worksheet, paper, and a pencil.

Vocabulary

light year: the number of miles light travels in one year

speed of light: 186,000 miles per second

When You Finish You Will Be Able To

Explain why astronomers use the unit "light year" when measuring large distances.

Activity

1. With your partner, choose from the list your teacher provides a part of your body to use as a measuring tool.
2. After your teacher has told you what to measure, each of you should measure while the other partner records the data. Compare your results with those of your partner.
3. Report your findings to your teacher and class.
4. After your class discussion has ended, try the "mind-boggling" Proper Measurement Worksheet. You may use a calculator if you wish.

Occupations Related to This Activity

(You may check the MATHCO Career Wall Charts to get more information about a career in which you are interested.)

OCCUPATIONS	SUBJECTS NEEDED IN HIGH SCHOOL

Are you interested in any of these careers? Remember, you can be anything you want to be--if you are qualified.

Men and women can do the same jobs with equal success. Can't both women and men enter each of the occupations you've listed above?

Exploring on Your Own

You might want to check in the encyclopedia to discover where the following units of measure originated: foot, yard, stone.

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MODULE 5, NUMBER 8 - PROPER MEASUREMENT

Worksheet

This MATHCO activity will blow your mind . . . or your calculator!

THE SPEED OF LIGHT IS 186,000 MILES PER SECOND

Using this information, try the following problems. (HINT: When multiplying, be sure to keep neat rows.)

1. How far does light travel in one minute?

11,160,000 miles

2. How far does light travel in one hour?

669,600,000 miles

3. How far does light travel in one day?

16,070,400,000 miles

4. How far does light travel in one year?

5,865,696,000,000 miles

5. Give at least one good reason why astronomers use the term "light year" instead of miles.

It makes the large numbers they work with smaller and simpler. The numbers involved in "light years" are easier for our minds to comprehend.

MODULE 5, NUMBER 9 - HYGROMETER

Teacher Activity Sheet

Overview

Your students will build an instrument that measures humidity, make some observations, and graph their humidity readings for at least a week. They will discover that humidity sometimes affects the way they feel.

Math Skills Your Students Will Need

Making graphs and finding needed information on a chart.

Time Allotment

One full class period plus five minutes of each succeeding class period for one week.

Objectives

Your students will:

1. Make an instrument that measures humidity.
2. Calculate humidity, using information on a chart.
3. Graph humidity readings for a week.
4. Discuss how humidity affects the ways people feel.
5. Calculate the comfort index, using information on a chart.

Materials Your Class Will Need

Your class will need two inexpensive thermometers that register the same temperature, a cotton shoestring, thread, an empty quart or half-gallon milk carton, string or rubber bands, and a small jar to hold water. Each student will need graph paper, a pencil, and a Hygrometer Informatio Sheet.

Vocabulary

anemometer: an instrument used to measure wind force and speed

barometer: an instrument used to determine the pressure of the atmosphere; it is used to help predict probable changes in the weather

comfort index: a scale of relative comfort, which varies with different combinations of temperature and humidity

humidity: the amount of moisture in the air

hygrometer: an instrument used to measure the relative humidity in the air

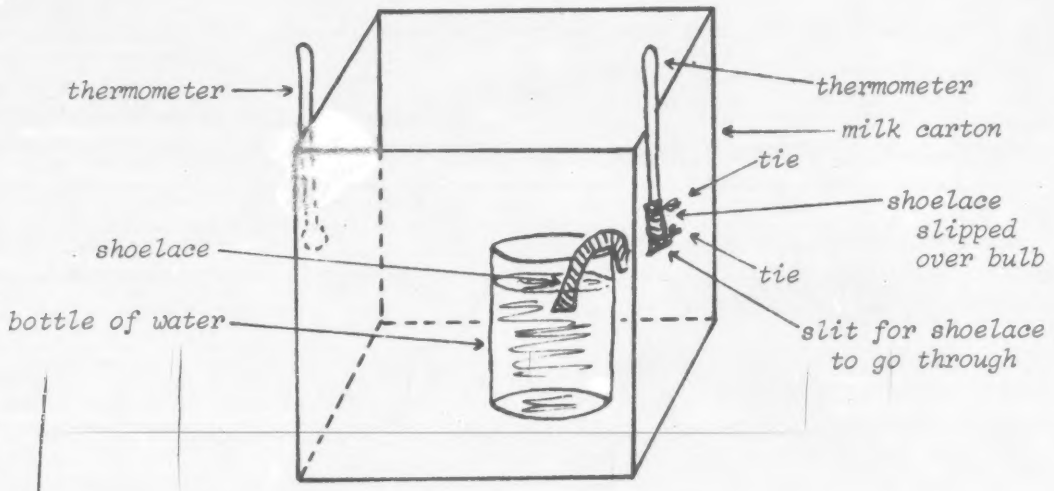
Self-Concept Builder

This is a group activity that all students will enjoy. Only the graphing is done on an individual basis.

Activity

1. With your class, construct the following instrument for measuring humidity:

DIAGRAM OF HYGROMETER



a. Take two thermometers and secure each to a side of an empty milk carton with rubber bands or string.

b. Make a slit in the carton under the bulb of one thermometer.

c. Cut a four- or five-inch section from a shoelace and slip it over the bulb of the thermometer under which you have made the slit.

d. Secure the shoelace with thread--tying one thread above and one thread below the bulb.

e. Fill the jar with water and place it inside the carton.

f. Place the end of the shoelace section through the slit and then into the jar in the milk carton.

2. When the shoelace is wet, fan the thermometers for a minute or two. Take a reading from both thermometers. Why is the reading of the wet thermometer lower?

3. With your students, look at the "Finding Relative Humidity in Percent" chart on their Hygrometer Information Sheet. Go over the example problem that is given to make sure your class understands how to use the chart. Then have your students use the thermometer readings you have just taken to find the relative humidity in your classroom.

4. Each student will set up a graph and record today's data.

5. Data should be collected and recorded on student graphs every day for one week.

6. Each day several students should be selected to go outside the school building to find the relative humidity. With the relative humidity and the temperature found by using the dry thermometer, they will share their findings with the class. Using the "Comfort Index" chart on their Hygrometer Information Sheet, your students will determine the Comfort Index. This information should also be charted each day.

Occupations Related to This Activity

What occupations might use an activity similar to this one? Have your students complete the career section on their Activity Sheet. After class discussion, they should add these occupations to the list:

SYNOPTIC METEOROLOGIST (specialist in forecasting weather)

PHYSICAL METEOROLOGIST (specialist in researching chemical and electrical properties of the atmosphere)

CLIMATOLOGIST (studies wind, rainfall, etc., to determine the general patterns of weather that make up an area's climate)

METEOROLOGICAL TECHNICIAN (aids other meteorologists in research by working with and developing new scientific instruments)

Discuss the types of courses people going into these occupations should take in high school. Have your students add these courses to their Activity Sheet.

Stress that men and women can be equally successful in most careers, if they are qualified.

Suggested Independent Activities

(These suggestions appear on Student Activity Sheet.)

1. Find some information about other weather instruments that you can make--such as an anemometer or a barometer--and construct them.

2. Use your knowledge about the comfort index in the summer to avoid heat stroke. You can usually get the temperature and humidity readings by listening to the local weather report.

3. After checking the humidity reading at school or at home, compare your findings with what the meteorologist reports on the local television weather program.

MODULE 5, NUMBER 9 - HYGROMETER

Student Activity Sheet

Your Name _____ Date _____

Overview

In this activity, you will build an instrument that measures humidity. This instrument is called a hygrometer. Each day for one week, you will measure the humidity in the air and record your results on a graph.

Math Skills You Need to Remember

Making graphs and finding needed information on a chart.

Things You Will Need

Your class will need two inexpensive thermometers that register the same temperature, a cotton shoestring, thread, an empty quart or half-gallon milk carton, string or rubber bands, and a jar to hold water. You will need graph paper, a pencil, and a Hygrometer Information Sheet.

Vocabulary

anemometer:	an instrument used to measure wind force and speed
barometer:	an instrument used to determine the pressure of the atmosphere; it is used to help predict probable changes in the weather
comfort index:	a scale of relative comfort, which varies with different combinations of temperature and humidity
humidity:	the amount of moisture in the air
hygrometer:	an instrument used to measure the relative humidity in the air

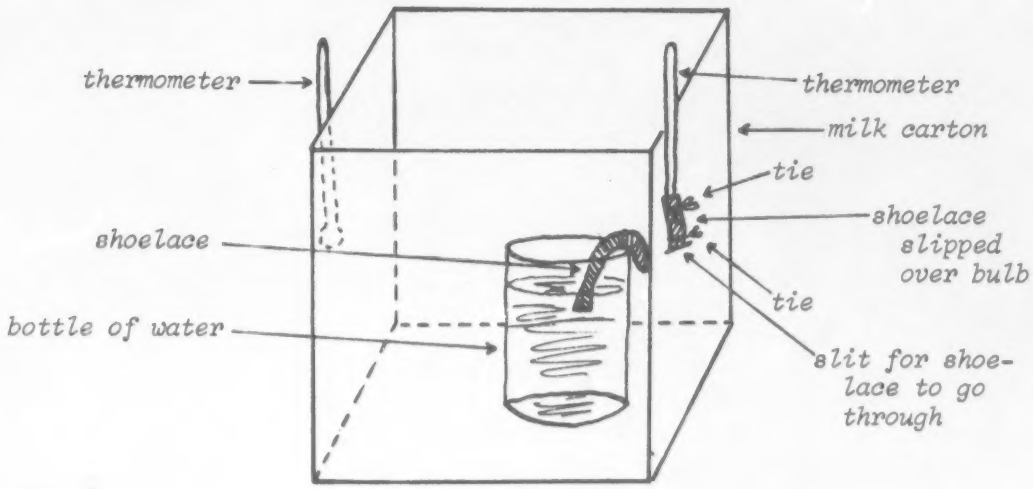
When You Finish You Will Be Able To

Use a hygrometer to measure humidity in the air.

Activity

1. As a class, you will construct the following instrument for measuring humidity:

DIAGRAM OF HYGROMETER



a. Take two thermometers and secure each to a side of an empty milk carton with rubber bands or string.

b. Make a slit in the carton under the bulb of one thermometer.

c. Cut a four- or five-inch section from a shoelace and slip it over the bulb of the thermometer under which you have made the slit.

d. Secure the shoelace with thread--tying one thread above and one thread below the bulb.

e. Fill the jar with water and place it inside the carton.

f. Place the end of the shoelace section through the slit and then into the jar in the milk carton.

2. When the shoelace is wet, fan the thermometers for a minute or two. Take a reading from both thermometers. Why is the reading of the wet thermometer lower?

_____

_____

3. Look at the "Finding Relative Humidity in Percent" chart on your Hygrometer Information Sheet. After your teacher has explained how the chart works, use today's readings to find the relative humidity in your classroom.

4. Use your graph paper to begin a graph and record today's data.

5. Each day for one week, you will collect data and record them on your graph.

6. Your teacher will send several students each day to go outside to find the relative humidity. Use the relative humidity and the temperature that they find with the dry thermometer to determine the comfort index rating for that day. Graph these findings each day. There is a "Comfort Index" chart on your Hygrometer Information Sheet.

Occupations Related to This Activity

(You may check the MATHCO Career Wall Charts to get more information about a career in which you are interested.)

OCCUPATIONS	SUBJECTS NEEDED IN HIGH SCHOOL
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Are you interested in any of these careers? Remember, you can be anything you want to be--if you are qualified.

Men and women can do the same jobs with equal success. Can't both women and men enter each of the occupations you've listed above?

Exploring on Your Own

1. Find some information about other weather instruments that you can make--such as an anemometer or barometer--and construct them.

2. Use your knowledge about the comfort index in the summer to avoid heat stroke. You can usually get the temperature and humidity readings by listening to the local weather report.

3. After checking the humidity reading at school or at home, compare your findings with what the meteorologist reports on the local television weather program.

FINDING RELATIVE HUMIDITY IN PERCENT

Difference in Degrees Fahrenheit between Wet-bulb and Dry-bulb Thermometers

Air Temperature (Reading of Dry-bulb Thermometer) in Degrees Fahrenheit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
30°	89	78	68	57	47	37	27	17	8																					
32°	90	79	69	60	50	41	31	22	13	4																				
34°	90	81	72	62	53	44	35	27	18	9	1																			
36°	91	82	73	65	56	48	39	31	23	14	6																			
38°	91	83	75	67	59	51	43	35	27	19	12	4																		
40°	92	84	76	68	61	53	46	38	31	23	16	9	2																	
42°	92	85	77	70	62	55	48	41	34	28	21	14	7																	
44°	93	85	78	71	64	57	51	44	37	31	24	18	12	5																
46°	93	86	79	65	59	53	46	40	34	28	22	16	10	4																
48°	93	87	80	73	67	60	54	48	42	36	31	25	19	14	8	3														
50°	93	87	81	74	68	62	56	50	44	39	33	28	22	17	12	7	2													
52°	94	88	81	75	69	63	58	52	46	41	36	30	25	20	15	10	6													
54°	94	88	82	76	70	65	59	54	48	43	38	33	28	23	18	14	9	5												
56°	94	88	82	77	71	66	61	55	50	45	40	35	31	26	21	17	12	8	4											
58°	94	89	83	77	72	67	62	57	52	47	42	38	33	28	24	20	15	11	7	3										
60°	94	89	84	78	73	68	63	58	53	49	44	40	35	31	27	22	18	14	10	6	2									
62°	94	89	84	79	74	69	64	60	55	50	46	41	37	33	29	25	21	17	13	9	6	2								
64°	95	90	85	79	75	70	66	61	56	52	48	43	39	35	31	27	23	20	16	12	9	5	2							
66°	95	90	85	80	76	71	66	62	58	53	49	45	41	37	33	29	26	22	18	15	11	8	5	1						
68°	95	90	85	81	76	72	67	63	59	55	51	47	43	39	35	31	28	24	21	17	14	11	8	4	1					
70°	95	90	86	81	77	72	68	64	60	56	52	48	44	40	37	33	30	26	23	20	17	13	10	7	4	1				
72°	95	91	86	82	78	73	69	65	61	57	53	49	46	42	39	35	32	28	25	22	19	16	13	10	7	4	1			
74°	95	91	86	82	78	74	70	66	62	58	54	51	47	44	40	37	34	30	27	24	21	18	15	12	9	7	4	1		
76°	96	91	87	83	78	74	70	67	63	59	55	52	48	45	42	38	35	32	29	26	23	20	17	14	12	9	6	4	1	
78°	96	91	87	83	79	75	71	67	64	60	57	53	50	46	43	40	37	34	31	28	25	22	19	16	14	11	9	6	4	1
80°	96	91	87	83	79	76	72	68	64	61	57	54	51	47	44	41	38	35	32	29	27	24	21	18	16	13	11	8	6	4
82°	96	91	87	83	79	76	72	69	65	62	58	55	52	49	46	43	40	37	34	31	28	25	23	20	18	15	13	10	8	6
84°	96	92	88	84	80	77	73	70	66	63	59	56	53	50	47	44	41	38	35	32	30	27	25	22	20	17	15	12	10	8
86°	96	92	88	84	80	77	73	70	66	63	60	57	54	51	48	45	42	39	37	34	31	29	26	24	21	19	17	14	12	10
88°	96	92	88	85	81	78	74	71	67	64	61	58	55	52	49	46	43	41	38	35	33	30	28	25	23	21	18	16	14	12
90°	96	92	88	85	81	78	74	71	68	64	61	58	56	53	50	47	44	42	39	37	34	32	29	27	24	22	20	18	16	14

Air Temperature (Reading of Wet-bulb Thermometer) in Degrees Fahrenheit

An example using the chart from page 97:

Temperature of dry-bulb thermometer 76°
Temperature of wet-bulb thermometer 68°

The difference is 8°

Find 76° in the dry-bulb column and 8° in the difference row. Where these two columns meet, you read the relative humidity. In this case, it is 67%.

Relative Humidity Percentage

TEMPERATURE °F	20	30	40	50	60	70	80	90	100
100	82	84	87	88	91	93	96	98	100
95	80	81	83	85	87	88	90	92	95
90	77	78	80	81	83	84	86	88	89
85	74	75	77	78	79	81	82	84	85
80	71	72	73	74	75	77	78	80	81
75	68	69	70	70	71	72	73	74	75
70	64	65	66	66	66	67	68	68	70
65	60	61	61	61	62	63	63	64	64
60	57	58	58	59	59	59	60	60	61

COMFORT INDEX

Use this chart the same way you used the "Finding Relative Humidity in Percent" chart.

Find the number closest to your dry-bulb temperature reading on the left-hand side of the above chart. Find the number closest to the relative humidity in the relative humidity percentage row. Where these two rows meet is the Comfort Index. The temperature ranges shown below indicate Comfort Index levels.

62 to 70 = comfortable

77+ = dangerous for heavy physical activity

82+ = dangerous for light physical activity

MODULE 5, NUMBER 10 - BALLOON ROCKETS

Teacher Activity Sheet

Overview

Your students will propel balloons across the room on a wire or string and calculate the speeds of the balloons.

Math Skills Your Students Will Need

Measuring, division, and using the second hand on a watch or clock.

Time Allotment

One to two class periods.

Objectives

Your students will:

1. Discover that moving air creates force; as air escapes from the back of the balloons the balloons move forward.
2. Calculate the speed at which their balloons moved.

Materials Your Class Will Need

Your class will need a long piece of string (room length), hooks or something to anchor the string at either end of the room, elongated balloons, straws (large enough to fit loosely on the string), masking tape, and a stopwatch. Each student will need paper and pencil (you might find that the use of a balloon pump would be helpful).

Vocabulary

propel: to move forward

speed: the distance traveled divided by the length of time of the trip

Self-Concept Builder

The experimental part of this activity is one that all students can do successfully, plus having lots of fun while making new discoveries about a familiar object.

Activity

1. Attach the string or wire to two walls of your classroom in such a way that one end can be unhooked from time to time, but can also be stretched tightly and secured. Or, two students may hold the strings tight if walls are not easily reached.

2. Your students will thread the string through a straw, allowing the straw to slide freely. They will secure the string to the wall. A balloon is then taped to the string and blown up. With a timer nearby, the balloon is released and its trip is timed. Allow for individual differences. Some students may want to blow up their balloons, tape them to the straw, and THEN place the straw on the string, which is then secured.

3. The distance the balloon traveled is measured. Have your students divide the distance traveled by the time it took. The results will be in feet per second.

4. Each student should have a turn, and when everyone has had a chance, compare the results. You might want to graph the class results on the board or have your students make their own graphs.

5. Discuss reasons for variations within the group. Have your students consider what might account for these variations. (Variations may occur because of long or short straws, elongated balloons or fat balloons, the tightness of the string, etc.)

Occupations Related to This Activity

What occupations might use an activity similar to this one? Have your students complete the career section on their Activity Sheet. After class discussion, they should add these occupations to the list:

AERONAUTICAL ENGINEER
PHYSICIST
SCIENCE TEACHER
TOY DESIGNER

Discuss the types of courses people going into these occupations should take in high school. Have your students add these courses to their Activity Sheet.

Stress that women and men can be equally successful in most careers, if they are qualified.

Suggested Independent Activities

(These suggestions appear on Student Activity Sheet.)

1. You could try for a distance record by modifying your balloon. Would controlling the flow of air help?

2. Compare the results of this experiment with the results of Activity 5, which measures lung capacity. Are there any similarities between these activities? Can they be explained?

MODULE 5, NUMBER 10 - BALLOON ROCKETS

Student Activity Sheet

Your Name _____ Date _____

Overview

In this activity, you will propel a balloon across the room on a string or wire and calculate its speed.

Math Skills You Need to Remember

Measuring, division, and using the second hand on a watch or clock.

Things You Will Need

Your class will need a long piece of string (room length), hooks or something to anchor the string at either end of the room, elongated balloons, straws (large enough to fit loosely on the string), masking tape, and a stopwatch. You will need paper and a pencil.

Vocabulary

propel: to move forward

speed: the distance traveled divided by the length of time of the trip

When You Finish You Will Be Able To

Form some conclusions about the effect of the force of air inside and outside of balloons.

Activity

1. A string or wire will be attached to two walls of your classroom or two students will hold the string stretched tightly.
2. Taking turns with your classmates, thread the string through a straw, secure the string to the wall, tape a balloon to the straw, and blow up the balloon.
3. When you are ready to time your balloon's trip, the balloon will be released.

4. Measure the distance your balloon traveled. Find the speed of your balloon by dividing the distance traveled by the time that it took. Your answer will be in feet per second.

5. What was the speed of your balloon? _____

6. When everyone in your class has had a chance, compare your results. You might want to graph the results of your entire class.

7. Your class has probably found many different speeds and distances. What might be the reasons for these differences?

_____

_____

_____

Occupations Related to This Activity

(You may check the MATHCO Career Wall Charts to get more information about a career in which you are interested.)

OCCUPATIONS	SUBJECTS NEEDED IN HIGH SCHOOL
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Are you interested in any of these careers? Remember, you can be anything you want to be--if you are qualified.

Women and men can do the same jobs with equal success. Can't both women and men enter each of the careers you've listed above?

Exploring on Your Own

1. You could try for a distance record by modifying your balloon. Would controlling the flow of air help?

2. Compare the results of this experiment with the results of Activity 5, which measures lung capacity. Are there any similarities between these activities? How can they be explained?

MODULE 5, NUMBER 11 - PENDULUM

Teacher Activity Sheet

Overview

In this activity, your students will time the swing of a pendulum, using different lengths of string and different weights for the bob, and will compare the differences and similarities.

Math Skills Your Students Will Need

Multiplication, keeping records, and timing.

Time Allotment

One class period.

Objectives

Your students will:

1. Discover that the length of the string affects the number of swings of the pendulum.
2. Discover that the mass (weight) of the bob does not affect the number of swings of the pendulum.
3. Use math skills they have already mastered to conduct a new experiment.
4. Work cooperatively in small groups.

Materials Your Class Will Need

Each small group will need string (two meters or six feet), washers or weights of some kind, a hook or tape (to attach the string to the ceiling, to a table, or to a meter stick suspended between two tables), and a watch with a second hand.

Vocabulary

arc:	something arched or curved; a continuous portion of a curved line
bob:	the mass (weight) at the end of the pendulum
pendulum:	an instrument consisting of a rod (or string) with a bob at the end, suspended so that it can swing freely to and fro, controlled by the force of gravity

Self-Concept Builder

Your students will be able to apply math skills they have mastered to discover something new through conducting this easy experiment.

Activity

1. Divide your students into small groups (the number of students per group is at your discretion).

2. Review the directions on the Student Activity Sheet with your class. Decide what length the string should be. Either pass our the materials each group will need or check to make sure someone from each group has brought the necessary materials.

3. Illustrate to your students how far the bob should be pulled back from the vertical to form a 12° arc.

4. One student from each group will tie the premeasured string to a weight and suspend the other end from a hook in the ceiling or from the table so that there is room for it to swing freely. It's best if each group uses the same type of bob.

5. They should then pull the bob back to no more than a 12° arc from the vertical and release it. Each student in the group will count and record the number of complete swings (back and forth) for ten seconds and multiply by six (to get the number of complete swings per minute).

6. Next, each group will shorten the string (without cutting it) to one-half the original length. They will repeat the experiment using the same arc.

7. Now, they will add more mass to the bob and repeat steps 4 through 6 (2 through 4 on the Student Activity Sheet). (There should be no difference in the number of swings per minute per pendulum.

8. In a class discussion, have the different groups compare their findings on this experiment.

9. Your students will now complete the Pendulum Worksheet.

Occupations Related to This Activity

What occupations might use an activity similar to this one? Have your students complete the career section on their Activity Sheet. After class discussion, they should add these occupations to the list:

ENGINEER
CLOCK MAKER
TOY DESIGNER (swing sets)
TRAPEZE ARTIST IN A CIRCUS

Discuss the types of courses people going into these occupations should take in high school. Have your students add these courses to their Activity Sheet.

Stress that men and women can be equally successful in most careers, if they are qualified.

Suggested Independent Activities

(These suggestions appear on Student Activity Sheet.)

Read about Foucault's pendulum. With a high ceiling and the school's or your parents' permission, you might construct one.

MODULE 5, NUMBER 11 - PENDULUM

Student Activity Sheet

Your Name _____ Date _____

Overview

In this activity, you will conduct an experiment to see how a pendulum works and what, if anything, will affect its swings.

Math Skills You Need to Remember

Multiplication, keeping records, and timing.

Things You Will Need

Each small group will need string (two meters or six feet), washers or weights of some kind, a hook or tape (to attach the string to the ceiling, to a table, or to a meter stick suspended between two tables), and a watch with a second hand.

Vocabulary

arc: something arched or curved; a continuous portion of a curved line

bob: the mass (weight) at the end of the pendulum

pendulum: an instrument consisting of a rod (or string) with a bob at the end, suspended so that it can swing freely to and fro, controlled by the force of gravity

When You Finish You Will Be Able To

Explain how pendulums work.

Activity

1. Your teacher and your class will go over the directions for the pendulum experiment you will be conducting. You will work in a group with several of your classmates.

2. Someone from your group should first measure the string and cut off the length decided upon by your class. Next, tie a weight to the string and attach the other end to a spot your group and teacher have decided upon.

3. Next, pull the weight back to no more than a 12° arc from the vertical and release it. Everyone in your group should count the number of complete swings (back and forth) for ten seconds. Multiply this number by six. What does this number represent?

   _____

   _____

   Record your findings. _____

4. Now, the string should be shortened (without cutting it) to one half of its original length, repeating the experiment exactly, and using the same arc. Record your findings.

   _____

5. Add more weight to the end of the pendulum and repeat steps 2 through 4, again recording your findings.

   _____

6. Be prepared to share your group's findings with the class.

7. Complete your Pendulum Worksheet.

Occupations Related to This Activity

(You may check the MATHCO Career Wall Charts to get more information about a career in which you are interested.)

OCCUPATIONS	SUBJECTS NEEDED IN HIGH SCHOOL
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Are you interested in any of these careers? Remember, you can be anything you want to be--if you are qualified.

Men and women can do the same jobs with equal success. Can't both women and men enter each of the occupations you've listed above?

Exploring on Your Own

Read about Foucault's pendulum. With a high ceiling and the school's or your parents' permission, you might construct one.

MODULE 5, NUMBER 11 - PENDULUM

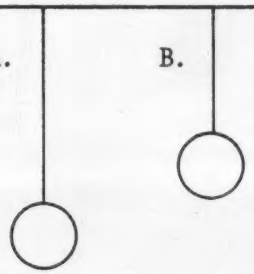
Worksheet

Now that you have done some experimenting with pendulums, use what you have observed to solve the problems below. Circle your answers to Questions 1 and 2 and fill in the blanks that follow each question.

1. Compared to Pendulum B, Pendulum A's swings per minute will be:

   fewer more the same

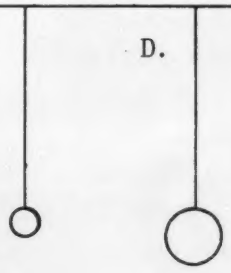
WHY? *Its string is longer.*



2. Compared to Pendulum C, Pendulum D's swings per minute will be:

   fewer more the same

WHY? *The strings are the same length.*



3. Which of these pendulums will swing the fastest?

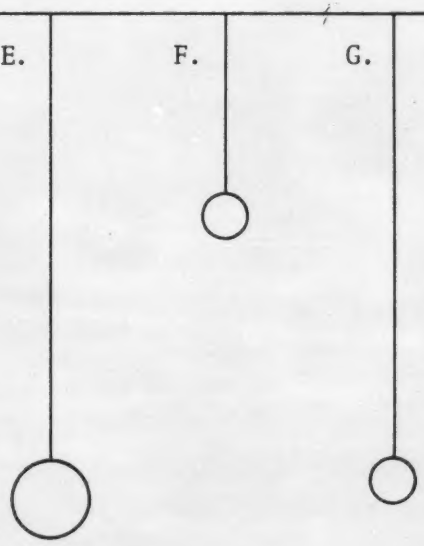
   Pendulum F.

WHY? *Its string is shortest.*

Which pendulum will swing the slowest?

Pendulum E, and also G.

WHY? *Both strings are equal/both are longer than Pendulum F.*



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4. In this MATHCO activity, which one variable (or change) did you and your group observe that affected the swing of a pendulum?

Changing the length of the string.

MODULE 5, NUMBER 12 - AIR POLLUTION

Teacher Activity Sheet

Overview

Your students will conduct an experiment collecting airborne particles in areas around the school. They will use these findings to determine which areas are most polluted.

Math Skills Your Students Will Need

Rating and graphing.

Time Allotment

Two class periods, one week apart.

Objectives

Your students will:

1. Categorize air pollution samples and rate them on an appropriate scale, e.g., dirtiest to cleanest--1 to 5.
2. Determine an appropriate way to graph their results.

Materials Your Class Will Need

A one-pound coffee can for each student, a one-pound coffee can with a plastic lid to use as a control, white poster board circles to fit the bottom of the cans, petroleum jelly, graph paper, pencils, and scissors.

Vocabulary

control group:	a group of things or people, similar to those in the experimental group, but not exposed to special conditions; this group is kept under normal conditions and can be compared with the experimental group
experimental group:	a group of things or people, exposed to certain conditions to see what effect, if any, these conditions have on them
graph:	a diagram consisting of a number of dots, lines, bars, etc., that represent the relationship between two or more things
rate:	to place in a particular rank or category

Self-Concept Builder

As students collect airborne particles and graph their results, they will gain first-hand information about their immediate environment, thus enhancing their appreciation for community and federal environmental standards.

Activity

1. Your students will cut poster board circles to fit the bottoms of their coffee cans, coat the circles with petroleum jelly, and place them in the cans, jelly side up.

2. Cover one can with a plastic lid and put it away as a control.

3. Place the other cans in selected areas around your school (inside and/or outside) at least four feet above the ground. It might be wise to put PLEASE DO NOT DISTURB signs on them. Cans should be labeled or numbered for identification.

4. One week later, have your students bring in the cans and decide how to rate them. You might rate them on a scale from 1 to 5, dirtiest to cleanest.

5. In groups, have your students decide on the best way to graph the results (e.g., bar graph, line graph, or broken-line graph).*

6. Each group will graph the results in the manner they have decided on, and perhaps all graphs might be displayed so everyone can see them.

7. Discuss with your students the implications of their findings.

Occupations Related to This Activity

What occupations might use an activity similar to this one? Have your students complete the career section on their Activity Sheet. After class discussion, they should add these occupations to the list:

ECOLOGIST

METEOROLOGIST

CITY PLANNER

PHYSICIAN (doctor)

OPHTHALMOLOGIST (eye doctor)

INDUSTRIAL POLLUTION REGULATOR/ INSPECTOR

*Small-group work is suggested for this graphing activity. Group the students so that each group includes all ability levels. The more capable students can assist other students in recording the findings.

Discuss the types of courses people going into these occupations should take in high school. Have your students add these courses to their Activity Sheet.

Stress that women and men can be equally successful in most careers, if they are qualified.

Suggested Independent Activities

(These suggestions appear on Student Activity Sheet.)

1. There is probably a local Environmental Protection Agency in your area. Call the agency and ask for information on air pollution. EPA might be interested in the results of the experiment done by your class.

2. Conduct this experiment on your own by comparing industrial-type city air to less polluted, nonindustrial air. (Be sure to get permission first.) Were the differences noticeable? Were your findings in this experiment what you expected?

3. Do some research on the various pollutants found in the air. What is the government (city, state, or federal) doing to help control air pollution?

MODULE 5, NUMBER 12 - AIR POLLUTION

Student Activity Sheet

Your Name _____ Date _____

Overview

In this activity, you will conduct an experiment to find out which areas around your school have the most and the least air pollution.

Math Skills You Need to Remember

Rating and graphing.

Things You Will Need

A one-pound coffee can, white poster board, petroleum jelly, graph paper, a pencil, and scissors.

Vocabulary

control group:	a group of things or people, similar to those in the experimental group, but not exposed to special conditions; this group is kept under normal conditions and can be compared with the experimental group
experimental group:	a group of things or people, exposed to certain conditions to see what effect, if any, these conditions have on them
graph:	a diagram consisting of a number of dots, lines, bars, etc., that represent the relationship between two or more things
rate:	to place in a particular rank or category

When You Finish You Will Be Able To

Conduct an experiment that uses an instrument you built to measure airborne particles (pollution, pollen, etc.) and graph your results comparing the control group to the experimental group.

Activity

1. Cut a white poster board circle to fit the bottom of your coffee can. Coat the poster board with petroleum jelly and put it in the can, jelly side up.

2. Be sure that one can used by your class is covered with a plastic lid and put away as a control.

3. Put a PLEASE DO NOT DISTURB sign on your can and label it for identification. Then place your can somewhere around the school at least four feet above the ground. Why do you think it must be placed at least four feet above the ground?

   _____

   _____

   _____

4. Do not touch or peek into your can for one week; after one week, bring it back to class.

5. With your classmates, look at all of the coffee cans that have been outside and all those that have been inside. Compare them to the control coffee can and decide how they should be rated (e.g., on a scale from 1 to 5, the dirtiest to the cleanest).

6. With your group, decide the best way to graph your results. Would a line graph or a bar graph be better? Can you think of another kind of graph to use?

7. Along with your group, graph your results. Your graph will be displayed, along with the graphs done by other groups, in your classroom.

8. What do the results of this experiment tell you?

   _____

   _____

   _____

Occupations Related to This Activity

(You may check the MATHCO Career Wall Charts to get more information about a career in which you are interested.)

OCCUPATIONS	SUBJECTS NEEDED IN HIGH SCHOOL

Are you interested in any of these careers? Remember, you can be anything you want to be--if you are qualified.

Women and men can do the same jobs with equal success. Can't both men and women enter each of the occupations you've listed above?

Exploring on Your Own

1. There is probably a local Environmental Protection Agency in your area. Call the agency and ask for information on air pollution. EPA might be interested in the results of the experiment done by your class.

2. Conduct this experiment on your own by comparing industrial-type city air to less polluted, nonindustrial air. (Be sure to get permission first.) Were the differences noticeable? Were your findings in this experiment what you expected?

3. Do some research on the various pollutants found in the air. What is the government (city, state, or federal) doing to help control air pollution?

MODULE 5, NUMBER 13 - LITTER STUDY

Teacher Activity Sheet

Overview

Your students will collect and classify the types of litter around your school and compare their results with the results of a nationwide study of litter.

Math Skills Your Students Will Need

Counting and figuring percentages.

Time Allotment

Two class periods.

Objectives

Your students will:

1. Collect litter found around your school.
2. Group the litter into given categories.
3. Compute the percentages of these categories.
4. Compare their results with a nationwide study's findings on litter.
5. Help promote school pride.

Materials Your Class Will Need

Trash bags, graph paper, and pencils. (Work gloves from home are optional.)

Vocabulary

biodegradable: capable of being decomposed by natural biological processes (anything that will easily decompose by bacterial action, such as some detergents in sewage disposal)

control: to test or verify an experiment by conducting a parallel (the same) experiment but omitting the one procedure under test so that the results can be compared

decompose: to undergo chemical breakdown, such as to decay or to rot

ecology: the study of the relationships between living things (organisms) and their environment

Self-Concept Builder

Your students will work in groups and become aware of their potential effect on the environment. In addition to conducting an experiment, your students will also be helping to promote school pride as they clean up the area around the school.

Activity

1. Divide your class into five groups and spend a designated period of time collecting litter around your school.
2. Your students will sort the trash into the following categories: glass, paper, metal, plastic, and miscellaneous.
3. Each of the five groups should take one category and count the number of pieces of trash in their category.
4. Have your class compute the total amount of trash collected by adding the number of pieces each group had.
5. Each group should compute the percentage of their category of trash to the whole by dividing the number of pieces in their category by the total number of pieces collected.
6. Have the class graph the results and also the following national averages:*

glass - 13.7%	plastic - 4.4%
paper - 44.1%	miscellaneous - 25.1%
metal - 12.7%	

Occupations Related to This Activity

What occupations might use an activity similar to this one? Have your students complete the career section on their Activity Sheet. After class discussion, they should add these occupations to the list:

*Office of Solid Waste, report issued August 1, 1977, U.S. Environmental Protection Agency.

ECOLOGIST	CHEMICAL ENGINEER
OCEANOGRAPHER	PARK MAINTENANCE WORKER
ENVIRONMENTAL ANALYST	RECYCLING CENTER MANAGER/OPERATOR

Discuss the types of courses people going into these occupations should take in high school. Have your students add these courses to their Activity Sheet.

Stress that women and men can be equally successful in most careers, if they are qualified.

Suggested Independent Activities

(These suggestions appear on Student Activity Sheet.)

You can discover what kinds of trash are biodegradable by burying small pieces of trash in milk cartons filled with dirt (e.g., hard candy, bread, a penny, paper). Keep a sample of each type unburied for a control. Water the dirt as though you had planted a seed. After a week, dig up the pieces and compare them with your control group. (This experiment may take a couple of weeks or longer, if desired.)

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MODULE 5, NUMBER 13 - LITTER STUDY

Student Activity Sheet

Your Name _____ Date _____

Overview

In this activity, you will conduct a litter study and compare your findings with the results of a nationwide study of litter.

Math Skills You Need to Remember

Counting and figuring percentages.

Things You Will Need

A trash bag, graph paper, and a pencil. You may use work gloves if you have them.

Vocabulary

biodegradable:	capable of being decomposed by natural biological processes (anything that will easily decompose by bacterial action, such as some detergents in sewage disposal)
control:	to test or verify an experiment by conducting a parallel (the same) experiment but omitting the one procedure under test so that the results can be compared
decompose:	to undergo chemical breakdown, such as to decay or to rot
ecology:	the study of the relationships between living things (organisms) and their environment

When You Finish You Will Be Able To

Conduct your own litter studies, using procedures similar to those used by a group conducting a nationwide study of litter.

Activity

1. Your teacher will assign you to one of five groups.
2. Your entire class will collect trash around your school for a certain period of time.

3. When you get back to the classroom, help sort the trash into the following categories: glass, paper, metal, plastic, and miscellaneous.

4. Your teacher will then give your group one of the categories to count. Count each piece of trash and arrive at a total for your group's category.

5. Each group will tell the class how many pieces of trash are in their category. As a class, add the five groups to find the total number of pieces of trash you collected.

6. Compute the percentage of your group's category of trash to the whole amount by dividing the number of pieces of trash in your category by the total amount of trash.

7. Graph the class results and also the following national averages:*

glass - 13.7%	plastic - 4.4%
paper - 44.1%	miscellaneous - 25.1%
metal - 12.7%	

Occupations Related to This Activity

(You may check the MATHCO Career Wall Charts to get more information about a career in which you are interested.)

OCCUPATIONS	SUBJECTS NEEDED IN HIGH SCHOOL

Are you interested in any of these careers? Remember, you can be anything you want to be--if you are qualified.

Women and men can do the same jobs with equal success. Can't both men and women enter each of the occupations you've listed above?

*Office of Solid Waste, report issued August 1, 1977, U.S. Environmental Protection Agency.

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Exploring on Your Own

You can discover what kinds of trash are biodegradable by burying small pieces of trash in milk cartons filled with dirt (e.g., hard candy, bread, a penny, paper). Keep a sample of each type unburied for a control. Water the dirt as though you had planted a seed. After a week, dig up the pieces and compare them with your control group. (This experiment may take a couple of weeks or longer, if desired.)

MODULE 5, NUMBER 14 - WHAT DO YOU GET WHEN YOU CROSS . . . ?
(Bonus Activity)

Teacher Activity Sheet

Overview

This activity, although not strongly mathematical or scientific, can be a fun activity for students and permit you, the math teacher, to become more aware of the creative and organizational potentials of your students.

In this activity, your students will be hypothetically crossing two dissimilar animals, doing research to learn the characteristics of these animals, and, after completing the Worksheet and drawing their animals, rating their own work.

This would be an excellent activity to do with a creative writing teacher and an art teacher in a team-teaching situation.

Math Skills Your Students Will Need

Knowledge of basic operations, knowledge of fractions, and ability to use math skills to their advantage while working independently.

Time Allotment

This will vary depending on how you decide to use this activity. If the activity is done by your entire class, two to three class periods would be appropriate. This activity, however, could be done by individual students, with a week or two allowed for them to complete their work outside of class.

Objectives

Your students will:

1. Do independent research.
2. Prepare a story within a fixed framework.
3. Apply mathematical principles that they know.
4. Rate their own efforts.

Materials Your Class Will Need

Bonus Activity Worksheet (in two parts), paper, crayons or colored pens or pencils, and pencils.

Self-Concept Builder

Students will be working with a unique animal combination. They will enjoy reading and viewing other students' work as well as sharing their own "animals." Rating their own work will help students to appraise their own abilities and efforts realistically.

Activity

1. This activity may be done with your entire class or by individual students on their own.

2. Have your students each pull two animals' names from a box. (See the Bonus Activity Animals Sheet on the next page. The names should be cut apart and folded before being put in the box.)

3. The students, using library and other resources, will research their animals and complete pages 128 and 129 (first two pages of the Bonus Activity Worksheet). Tell them that the second question (I am 1/3 walrus and 2/3 parrot, for example) refers to fractions. Suggest to them that they keep a list of the other times they use math in this assignment, as they will be needing this information later on (for the third page of the Worksheet).

4. After your students have completed these pages, they will rate their efforts by completing pages 130 and 131 (the last two pages of the Bonus Activity Worksheet). (You will probably want to wait until after they have completed the first two pages before showing them the other two pages.)

5. Review each student's work and his or her rating with the student.

6. Some students may want to share their "animals" with the class or construct a bulletin board to display everyone's efforts.

Bonus Activity Animals (for teacher's use)

WHALE	HYENA	DOG	ELEPHANT
CAT	FLAMINGO	MOOSE	TIGER
CHICKEN	ROOSTER	LION	CHIPMUNK
SQUIRREL	DEER	GERBIL	GUINEA PIG
LEOPARD	ZEBRA	OSTRICH	SNAIL
PIG	COW	EAGLE	ROBIN
RATTLESNAKE	HAWK	PORPOISE	CENTIPEDE
HONEY BEE	BAT	BOA CONSTRICTOR	GAZELLE
HORSE	TURTLE	CHAMELEON	STORK
ELK	PARROT	HUMMINGBIRD	PRAIRIE DOG
GORILLA	CHIMPANZEE	RHINOCEROS	BEAVER
GIRAFFE	SKUNK	HIPPOPOTAMUS	WALRUS

TEACHERS: You will probably need to make two or three copies of this sheet per class. Cut the names out using a paper cutter, fold them, and put them into a box from which students will pull two animals each.

MODULE 5, NUMBER 14 - WHAT DO YOU GET WHEN YOU CROSS . . . ?
(Bonus Activity)

Worksheet

Your Name _____ Date _____

WHAT DO YOU GET WHEN YOU CROSS A _____ and a _____?
YOU GET A _____ AND THIS IS HIS OR HER STORY:

My name is _____ and I live _____

_____.

I am / _____ and / _____.

When you first see me, you immediately notice that _____

_____

_____.

My nose is _____ because _____

_____.

My mouth is _____ because _____

_____.

My eyes are _____ because _____

_____.

I weigh about _____ and I'm _____ tall.

I move very _____ because _____

_____.

I eat _____

_____

_____.

The sounds that I make are _____

_____.

What I like to do best is to _____

_____

_____.

The things I don't do very well are _____

_____. This is because _____

_____.

The things I do extremely well are _____

_____. This is because _____

_____.

You wouldn't want to get too close to me because _____

_____

_____.

You'll never see me in a zoo because _____

_____

_____.

Please see the attached picture of me, which shows how I look. You should especially notice _____

_____

_____.

Your Name _____ Date _____

Please rate your work on this MATHCO Module 5 Bonus Activity as follows:

PART A: Circle the number on the rating scale that best expresses the way you feel about your work.

	POOR		AVERAGE		EXCELLENT
1. My attitude concerning this activity (regardless of the animals I picked) was	1	2	3	4	5
2. The amount of time I spent on this activity was	1	2	3	4	5
3. The evidence that I did some research to prepare the best answers possible is	1	2	3	4	5
4. The creativity that my answers show is	1	2	3	4	5
5. My artwork (idea-wise) I'd rate	1	2	3	4	5
6. My artwork (as a thing of beauty) I'd rate	1	2	3	4	5
7. The neatness of my handwriting in completing this activity was	1	2	3	4	5
8. The chances that someone else would like to take a look at what I've done on this assignment are	1	2	3	4	5

PART B: List the ways you used math to help you complete this activity.

_____

_____

_____

_____

_____

PART C: On the lines below, explain how you feel you could have done a better job on this activity.

PART D: Was there anything else about your animal that you would have liked to include, but didn't because of how the activity page was worded or spaced?

If so, please use the lines below to tell more about your animal.

PART E: If you were grading your Bonus Activity Worksheet, what grade would you give yourself? _____

Why?

PART F: How do you feel about receiving grades for things you do for fun?

Please explain.